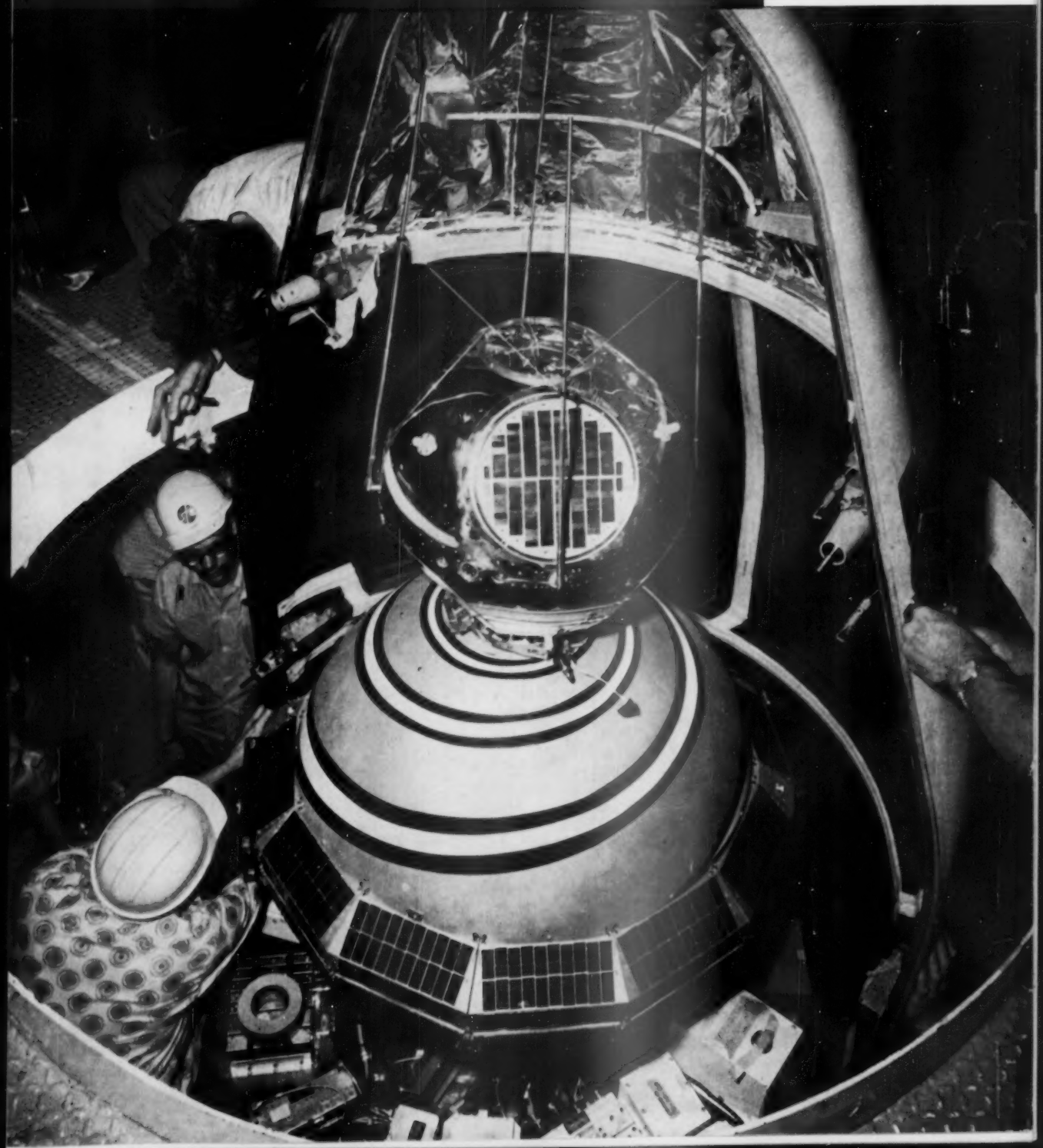
Aviation Week
and Space Technology

July 11, 1960

Fan Burner Engine Studied For Transports

Transit II-A Dual Payload Installed



AEROJET'S

AbleStar

RestartABLE

April 13, 1960, marks a dramatic milestone in American propulsion technology – the first successful restart of a rocket engine in outer space. The mission, under Air Force Ballistic Missile Division management—launching of the ARPA-Navy Transit navigational satellite into precise orbit. The propulsion system: Aerojet's AbleStar upper stage.

ReliABLE

AbleStar's spectacular achievement carries to a new pinnacle the unrivaled reliability pattern of Aerojet's ABLE series—15 tries, 15 triumphs—in launchings conducted for the Department of Defense and the National Aeronautics and Space Administration.

AvailABLE

Produced by Aerojet-General, under systems management performed by Space Technology Laboratories, the AbleStar was designed, developed, qualified and flown in less than one year from contract inception. Simple, low-cost AbleStar upper stage engines are available now for immediate contributions to America's space programs.

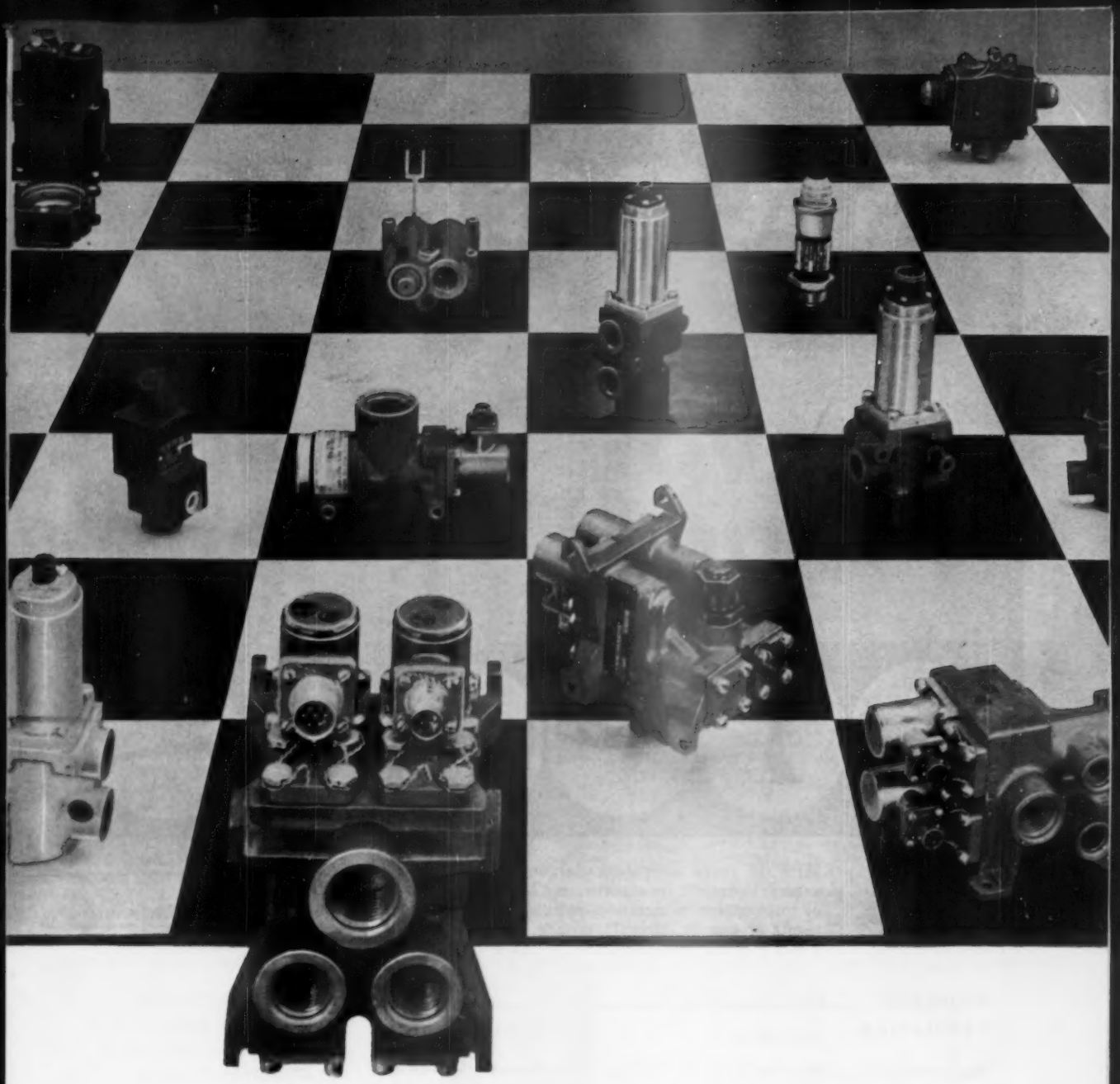
A product of the
Aerojet Systems Division

Aerojet-General®
CORPORATION
Azusa, California

A SUBSIDIARY OF THE GENERAL TIRE AND RUBBER COMPANY

FIRST RESTART IN SPACE

Engineers, scientists—investigate outstanding opportunities at Aerojet



Problem-solving hydraulic valves a 17-year specialty at Hydro-Aire

Thousands of models—more than 111,600 hydraulic valves, pumps, and controls since 1943. That's a lot of problems solved, for a lot of design and project engineers involved in airborne hydraulics. Have we helped you yet? There's a good chance we have the answer to your problem readily available. If not, our accumulated experience and complete facility give a head start toward on-time delivery. Try us. Send Hydro-Aire your specifications for a prompt quote. And, write on your letterhead for a free copy of our catalog.

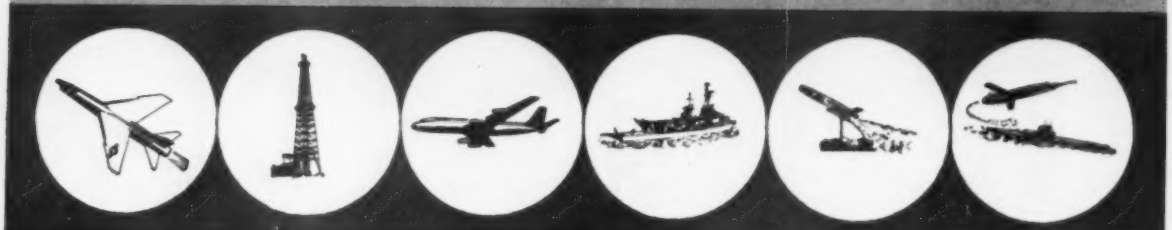
Engineers: write D. B. Nickerson, Chief Engineer, regarding career opportunities at Hydro-Aire.

HYDRO-AIRE
3000 WINONA AVENUE
BURBANK, CALIFORNIA
Developers and producers of reliable control components, sub-systems and systems for aircraft, missiles, electronics, transportation and general industry.

DIVISION OF CRANE CO.

SARGENT

SERVO-SYSTEMS OF FORCE CONTROL



With 38 years acceptance Sargent builds precision linear and rotary hydraulic, pneumatic, mechanical and electronic systems of force control to meet successfully the increasingly high requirements of marine, aircraft, missile, petroleum and industrial use. From original idea to finished product – SARGENT.

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- Assembly

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- Hydraulic Systems
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- Hydraulic Actuators
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- Hydraulic Motors
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- Pneumatic Valves
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"GOOD WILL" is the disposition of the pleased customer to return to the place where he has been well treated.
– U.S. Supreme Court

AVIATION CALENDAR

July 18-19—Liquid Rockets and Propellants Conference, American Rocket Society, Ohio Union Building, Ohio State University, Columbus, Ohio.

July 18-19—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Beverly Wilshire Hotel, Beverly Hills, Calif.

July 21-27—Third International Medical Electronics Conference & Exhibition (including session on medical electronics in space research), London, England.

July 28-29—Seventh Annual Symposium on Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.

Aug. 1-3—Fourth Global Communications Symposium, Statler Hilton Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers; U. S. Army Signal Corps.

Aug. 1-3—"Future of Manned Military Aircraft" (Classified Meeting), Institute of the Aeronautical Sciences, El Cortez Hotel, San Diego, Calif.

Aug. 2-11—27th Annual U. S. National Soaring Championships, Ector County Airport, Odessa, Tex.

Aug. 8-11—Western National Meeting, American Astronautical Society, Olympic Hotel, Seattle, Wash.

Aug. 8-12—1960 Pacific General Meeting, American Institute of Electrical Engineers, El Cortez Hotel, San Diego, Calif.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Aug. 16-18—Fourth Annual Tri-Service Conference on Biological Effects of Microwave Radiation, New York University Post-Graduate Medical School, NYU Medical Center, N.Y.C. Sponsor: Air Research and Development Command.

Aug. 18-19—Second International Symposium on Submarine and Space Medicine, Laboratory of Aviation and Naval Medicine, Karolinska Institute, Stockholm.

(Continued on page 6)

AVIATION WEEK and Space Technology

July 11, 1960
Vol. 73, No. 2

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Engineering notes from the **SM/I REPORTER**

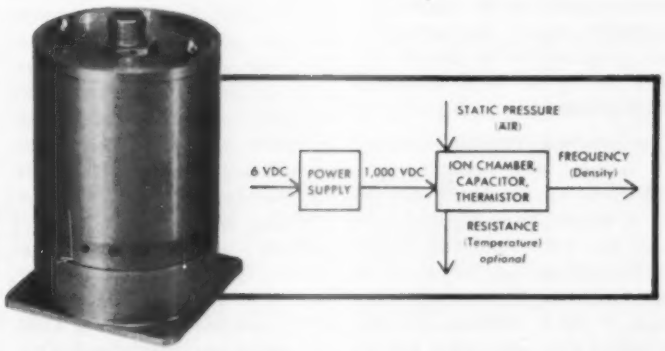
BY STANLEY M. INGERSOLL, *Capabilities Engineer*

Report No. 7
TR 2043-2 Glow Discharge Densitometer

This instrument was developed by our Research Division from investigations into ionization phenomena. It employs the glow discharge phenomenon between two electrodes to measure the density of a gas between the electrodes, which enables it to measure altitudes of 40,000-250,000 feet to an accuracy of ±1,000 feet. When this unit is used as a pressure measuring device the accuracy is ±5% of the pressure reading. At these higher altitudes the TR 2043-2 takes over from common barometric instruments or mechanical pressure sensing elements which are impractical because of their inaccuracy at very low pressures. The instrument consists of a power supply and an ion chamber packaged in a cylindrical aluminum case four inches long and three inches in diameter. Because it does not depend on elastic elements, this SM/I sensor is extremely insensitive to shock, vibration and acceleration.

Typical Performance Specifications

Inputs:	Static pressure, ram pressure, temperature
Outputs:	Frequency, typical range 0 to 1000 cps Resistance, typical range 20K to 2 Megohm Temperature, thermistor output 20K to 2 Megohm
Accuracy:	±5% of pressure reading or ±1,000 feet altitude absolute
Range:	40,000 to 250,000 feet (Adaptable for higher ranges)
Response Time:	0.1 seconds maximum
Power Requirements:	3.5 watts at 6 VDC including 1 watt heater power
Temperature Range:	−65°F to +170°F
Vibration:	50 g's 10-2000 cps
Shock:	100 g's
Size:	3 inches dia. x 4 inches long
Weight:	1 lb. 4 oz.

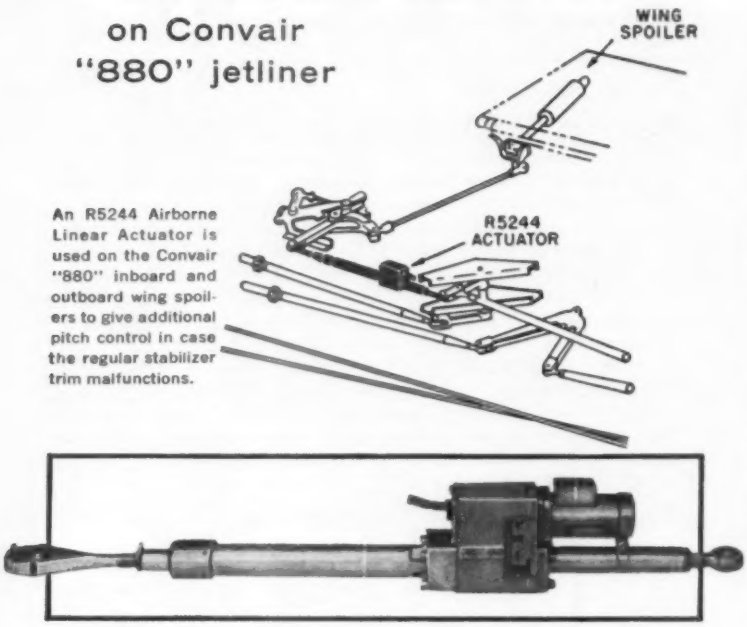


For more information and complete operating specifications, write or wire SM/I today. Address your inquiry to Stanley M. Ingersoll, Capabilities Engineer.

SM/I
SERVOMECHANISMS/INC.
Los Angeles Division
12500 Aviation Boulevard
Hawthorne, California

Airborne actuator selected for wing spoiler systems

on Convair "880" jetliner



An R5244 Airborne Linear Actuator is used on the Convair "880" inboard and outboard wing spoilers to give additional pitch control in case the regular stabilizer trim malfunctions.

Airborne's linear actuators are used by Convair Division of General Dynamics Corporation in the Convair "880" jetliner to provide a secondary flight control system to retain control of aircraft attitude should the primary control surfaces become inactive. By electrically controlling the actuators through a set of switches in the cockpit, the pilot can fly the "880" using the wing spoilers.

Convair's design problem called for an actuator that would operate effectively from sea level to 40,000 ft., at temperatures ranging from −65° to +140°F, and with a duty cycle of 10 sec. on, 5 min. off at a maximum tension or compression load of 320 lb. without any risk of failure even after being unused for long periods of time. Airborne provided a specially built R5244 unit meeting these requirements with a total weight of only 3 lb.

This is only one example of many specially built Airborne actuators relied on by aircraft designers to carry out vital functions in modern missiles and aircraft. Whatever your special design problem, we will build an actuator to your specifications that will do the job dependably and safely. Where your requirements are not unique, we can provide a line of modular-type actuators, both linear and rotary, that can simplify design and specification. Give us the facts on your particular need and we will be happy to submit a proposal. Contact any of our offices for further information.

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Engineered Equipment for Aircraft and Industry

AIRBORNE ACCESSORIES CORPORATION

HILLSIDE 5, NEW JERSEY • Offices in Los Angeles and Dallas

AVIATION CALENDAR

(*Continued from page 5*)

Aug. 18-19—Electronic Packaging Symposium, University of Colorado, Boulder.

Aug. 23-25—1960 Cryogenic Engineering Conference, University of Colorado.

Aug. 23-26—Western Electronic Show & Convention, Los Angeles Memorial Sports Arena, Los Angeles, Calif.

Aug. 28-Sept. 5—1960 National Air Rally, Municipal Airport, Orange, Mass. Sponsor: National Aeronautic Assn.

Sept. 4-5—Civilian, Closed-Course Airplane Races, Lakefront Airport, Cleveland.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 7-9—Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass. Sponsors: Instrument Society of America; American Society of Mechanical Engineers; American Institute of Electrical Engineers; Institute of Radio Engineers; American Institute of Chemical Engineers.

Sept. 8-9—1960 Engine and Operations Symposium, Airwork Corp., Millville, N. J.

Sept. 12-13—Sixth Annual Titanium Metallurgy Conference, New York University's College of Engineering, Bronx, N. Y.

Sept. 12-16—16th Annual General Meeting, IATA, Copenhagen, Denmark.

Sept. 12-16—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.

Sept. 14-16—Annual Meeting, National Assn. of State Aviation Officials, Wort Hotel, Jackson, Wyo.

Sept. 15-16—15th Annual Meeting, Armed Forces Chemical Assn., Sheraton-Park Hotel, Washington, D. C.

Sept. 19-22—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Shoreham Hotel, Washington, D. C.

Sept. 21-25—National Convention and Aerospace Panorama, Air Force Assn., Civic Auditorium and Brooks Hall, San Francisco, Calif.

Sept. 25-27—24th Annual Convention, International Northwest Aviation Council, Harrison Hot Springs, British Columbia.

Sept. 27-30—Space Power Systems Conference, American Rocket Society, Miramar Hotel, Santa Monica. Cosponsors: USAF; U. S. Army; U. S. Navy; NASA; AEC.

Oct. 3-5—Sixth National Communications Symposium, Institute of Radio Engineers, Utica, N. Y.

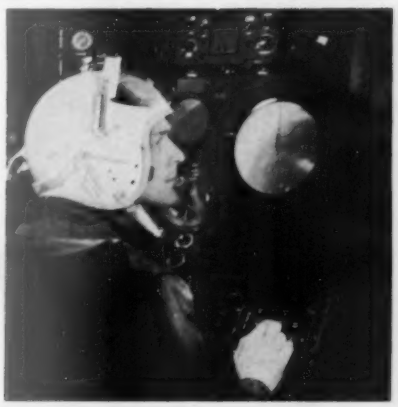
Oct. 3-5—Seventh Annual Meeting, Institute of Radio Engineers' Professional Group on Nuclear Science, Gatlinburg, Tenn. Cosponsor: Oak Ridge National Laboratory.

Oct. 3-5—National Midwestern Conference on Air Logistics, Institute of the Aeronautical Sciences, Tulsa, Okla.

Oct. 3-5—First International Air Traffic Control Conference and Fifth Annual Meeting of the Air Traffic Control Assn., Sheraton-Palace Hotel, San Francisco.

Oct. 10-14—Society of Automotive Engineers National Aeronautic Meeting, including USAF Office of Scientific Research Astronautics Conference, Ambassador Hotel, Los Angeles, Calif.

The elements of guidance and control:



Data Acquisition and Application Subsystems—IBM has proven capabilities to provide real-time man-to-machine and machine-to-machine elements of weapon guidance systems. In addition to the Bombing-Navigation system with its visual displays in the B-52, IBM also provides interface devices to apply this system to air-launched missile guidance. Federal Systems Division experience in air-based and ground-based guidance systems is proven in operation.

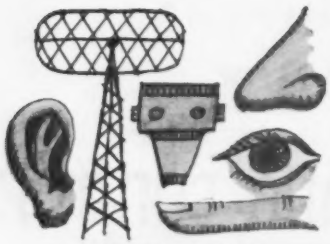
Data Communications Subsystems—The SAGE data processing system, heart of America's air defense network, embodies advanced communications devices and techniques required to filter and direct an enormous flow of data. Designed and built by the Federal Systems Division, the AN/FSQ-7, an advanced system in operation, embodies processing and communications power to direct defense operations as well as to guide missiles from remote sites.

Data Processing and Control Subsystems—Now in development, the Advanced Bombing-Navigation and Missile Guidance system is another example of IBM's "closed-loop" system capability. This system satisfies the operating requirements of high-speed, long-range weapon systems. Compact, reliable equipment such as this and Federal Systems Division's computer for the Titan missile guidance system are the result of IBM's vast background in data processing and control.

all systems capabilities of IBM

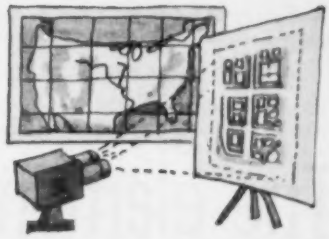
IBM's experience in data processing and data communications, supplemented by an extensive background in data acquisition, adds up to a three-way capability for developing, producing and integrating total automated systems. This capability is being advanced through continuing research in miniature high-speed devices for high-reliability guidance systems of the future.

Federal Systems Division, 326 East Montgomery Avenue, Rockville, Maryland IBM

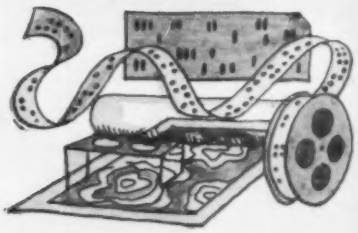


SENSORS

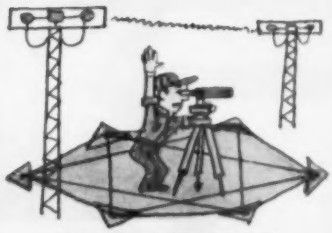
SIMULATORS



DISPLAY DEVICES



INTELLIGENCE



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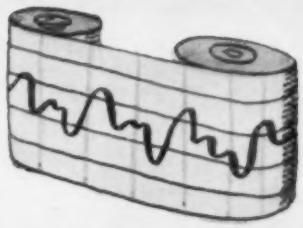

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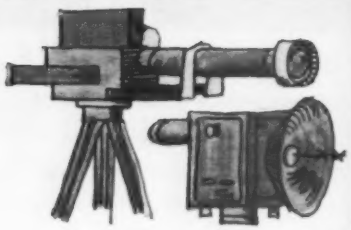
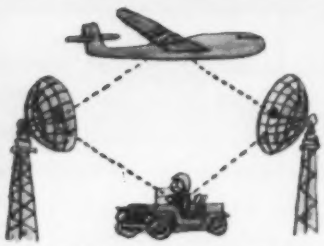
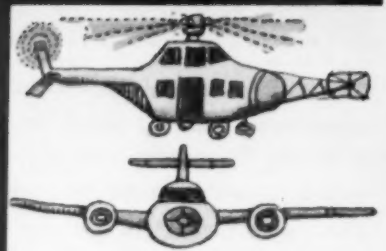


INSTRUMENTATION



VEHICLE TRACKING



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A possible Earth to Venus Trajectory (dotted line) for 107-day flight programmed for burnout conditions over Cape Canaveral on 16 January 1961 at 15.65 hours (ephemeris time). Illustration shows positions of Earth, Venus, vehicle at eighteen-day intervals.

MISSILE AND SPACE VEHICLE DEPARTMENT

...center for missile and space technology research and development at General Electric

Progress in defining space trajectories

Astrodynamicists at General Electric's Missile and Space Vehicle Department are currently mapping space . . . determining trajectories for flights from the Earth to other bodies of our solar system.

Under these funded studies, MSVD has recently completed a program of error analysis of trajectories to the Moon involving the four-body gravitational system, as well as a study of flight paths to Venus.

From consideration of the total gravitational field, specific space missions are computed when date of departure, trip time and launch site are specified. The exact launch burnout conditions are determined for the time of day which maximizes the additional boost caused by the Earth's rotation. Employing new techniques, MSVD scientists have made these determinations with as few as three corrective computer runs. These methods also can be applied to flights to other planets of our solar system.

In addition, the Department is developing methods to determine orbital parameters of earth satellites using only Doppler information. This MSVD experience in tracking techniques and computer programs permitted analysis of the Russian Lunik III trajectory.

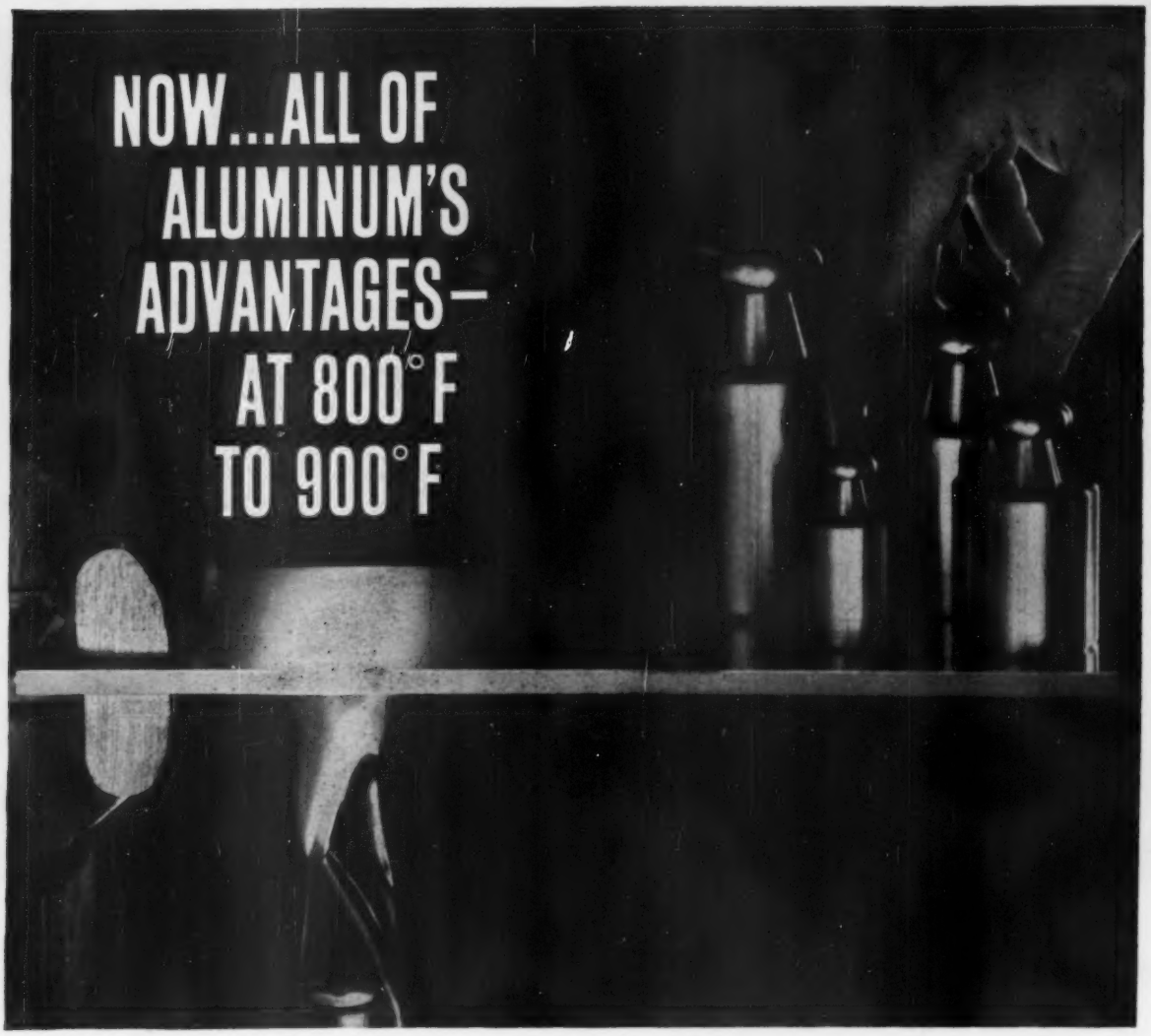
For more information about MSVD's progress in all phases of space technology, write for the new Department Bulletin, Section 160-92, General Electric Co., Missile and Space Vehicle Department, Philadelphia 1, Penna.

GENERAL ELECTRIC

MISSILE AND SPACE VEHICLE DEPARTMENT

A Department of the Defense Electronics Division

Scientists and Engineers interested in career opportunities in Space Technology, contact Mr. T. H. Sebring, Dept. 160, MSVD



New Powder Metallurgy Products Broaden Aluminum's Defense Applications

THE TRADITIONAL advantages of aluminum—at temperatures up to around 500°F—can now be extended to temperatures hundreds of degrees higher than conventional aluminum can take.

THANKS TO Alcoa's pioneering with the metallurgical technique known as "dispersion hardening," solid aluminum products reformed from *powdered* aluminum by heat and pressure take on new qualities. They are fine-grained, hard, tough, sapphire-like in brilliance, and amazingly resistant to heat effects.

ALUMINUM POWDER metallurgy products—"APMP" for short—are available in a family of four alloys. They are usually extruded into forms which can subsequently be further extruded, rolled, forged, drawn or impacted by conventional metal-working methods. Where you need the properties of aluminum, but where temperatures seem "too high" for conventional aluminum products, chances are that one of these four alloys may solve a host of hectic problems.

THE SUCCESSFUL development of these new APM alloys suggests what can happen when Alcoa research is applied to defense projects. We always stand ready to take on Research and Development assignments of a similar nature. For more information on APM alloys or Alcoa's R&D capabilities, write: Aluminum Company of America, 2026-G Alcoa Building, Pittsburgh 19, Pa.

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EDISON

resistance temperature detectors meet or exceed

MILITARY STANDARDS

Edison Industries, acknowledged leader in the field of temperature measurements, offers a complete line of Military Standard Resistance Temperature Detectors having faster response speed, longer life and greater accuracy than required by the military specifications.

Designed for such applications as the measurement of cylinder head temperatures, lube oil temperatures, and rocket fuel temperatures, these rugged detectors offer unmatched accuracy, sensitivity, speed of response, and give years of maintenance-free service.

In addition to the Military Standards, Edison offers a wide variety of detectors for unusual purposes. Years of experience in the manufacture of temperature detectors for new and difficult applications provide Edison engineers with the ability to design and fabricate special detectors to meet your most exacting requirements.

For complete information on Standard Edison RTD's write for Publication 3016, or send us your specifications for special design requirements.

Edison RTDs meet or exceed the requirements of:

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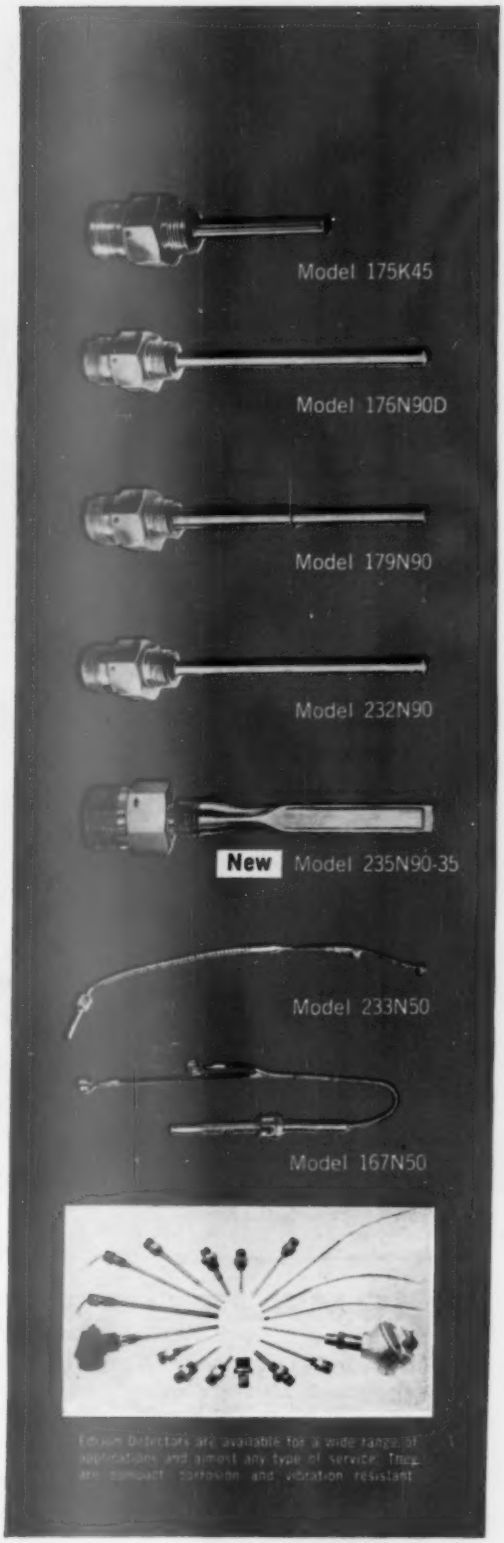
MIL-B-7370A	**MIL-T-25446B (USAF)**

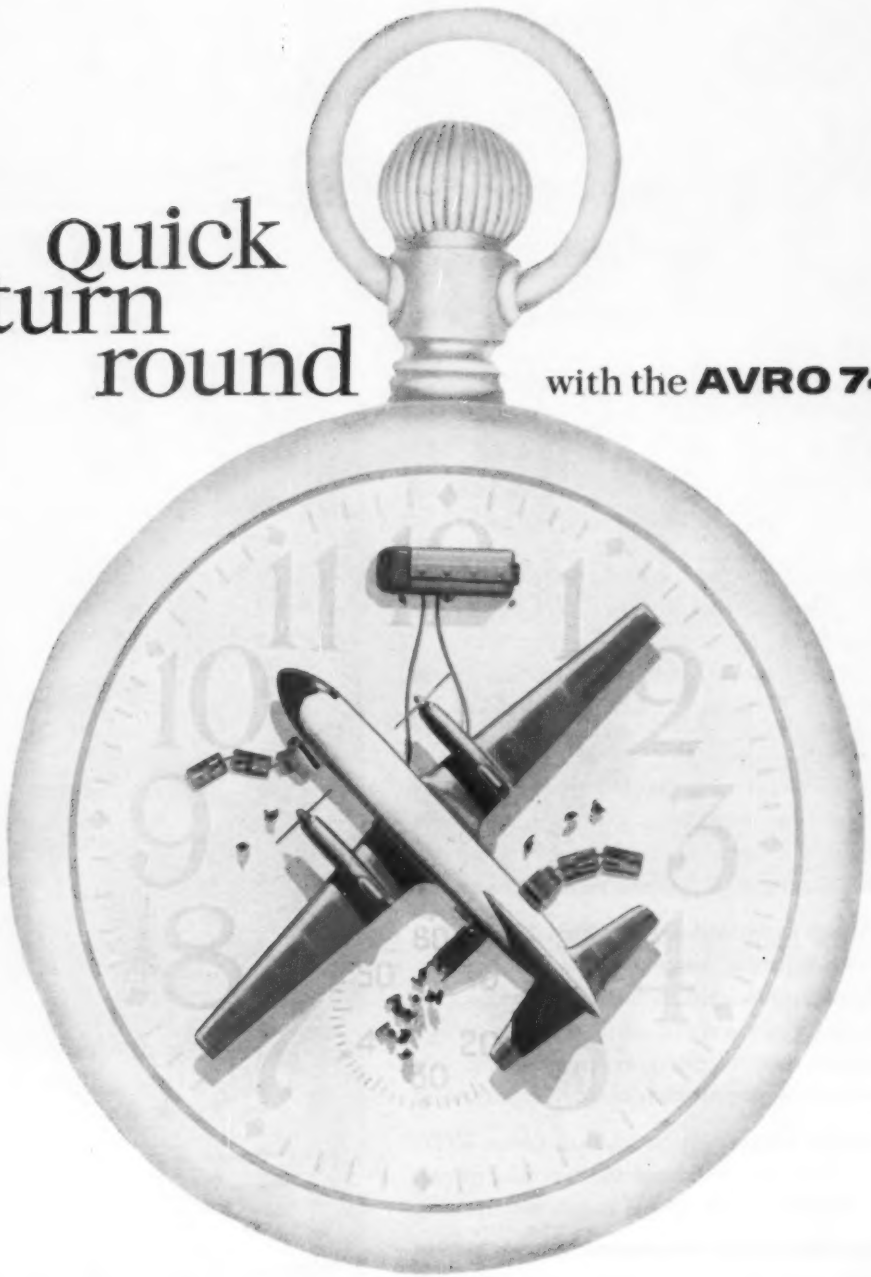


Thomas A. Edison Industries

INSTRUMENT DIVISION

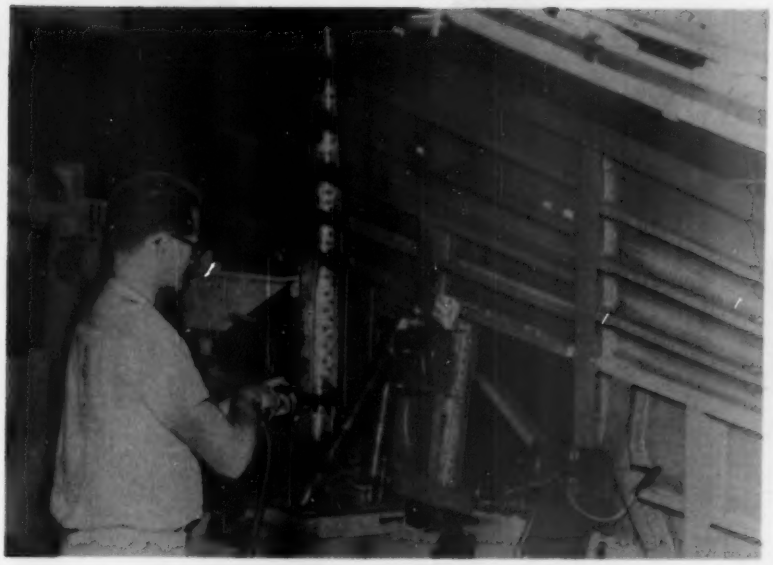
49 LAKESIDE AVENUE, WEST ORANGE, N. J.

quick turn round with the **AVRO 748**



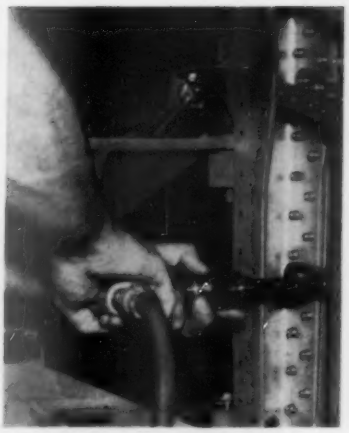
Ground time is lost time where airline economy depends on rapid aircraft turn round. The Avro 748 has been designed as a quick-service, low-cost aircraft. With such features as a port engine propeller brake, front and rear access doors on the port side, separate baggage door on the starboard side and provision for air stairs, the AVRO 748 reduces halt time to a minimum of three minutes! *For facts and figures on this oustanding aircraft, write to:*

HAWKER SIDDELEY AVIATION
32 Duke Street, St. James's, London, S.W.1

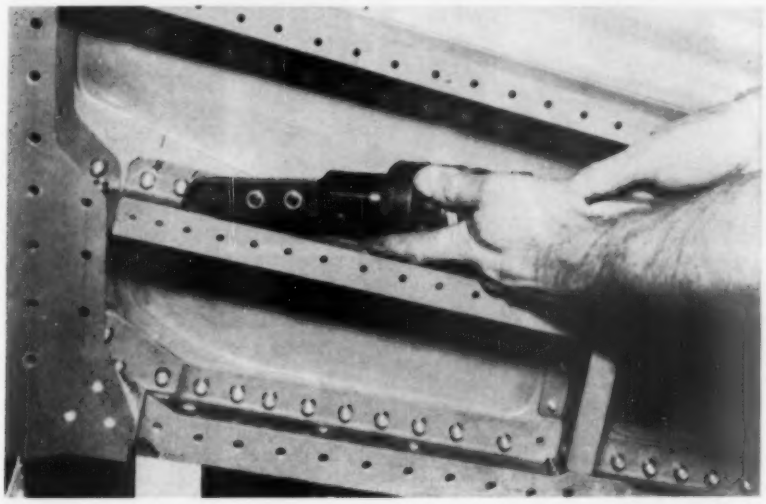


Upper photo: Hi-Loks fasten the entire lower skin panel to ribs and beams.

Lower photo: Modified 20° attachment tool on Keller Air Driver installs Hi-Loks on beam flanges. The Hi-Lok installation is quiet and eliminates the progressive pounding to the structure normally associated with the installation of swage type fasteners using pneumatic hammers.



Hi-Lok 2" offset extended adaptor fitted to an Ingersoll-Rand Air Motor reduces a 2-man, 32-hour assembly job on the landing gear steel support rib to a one-man, 4-hour job. Additionally, the change to Hi-Loks reduced the installed fastener rejection rate from 30% to practically nil.



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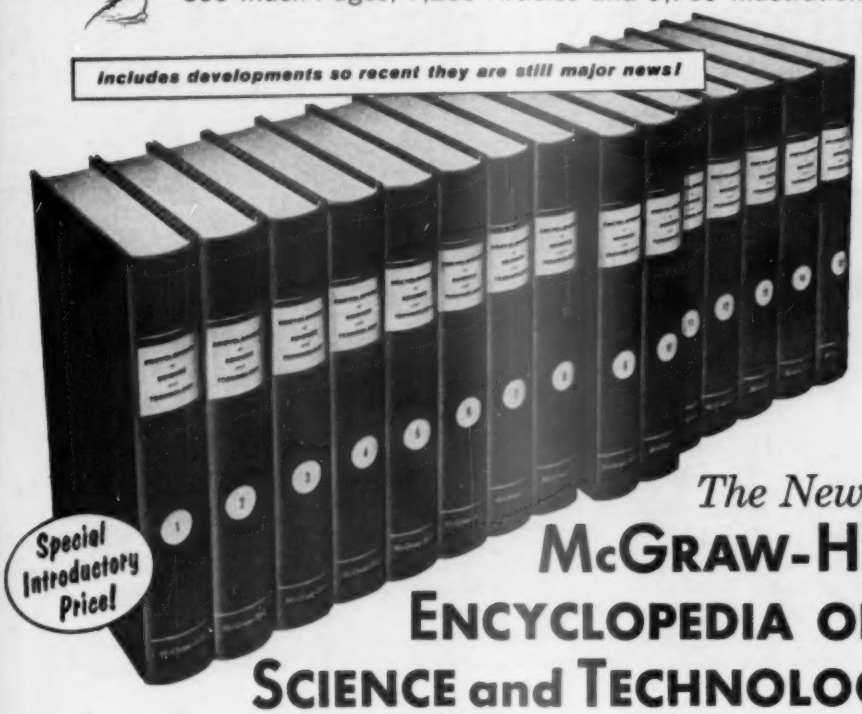

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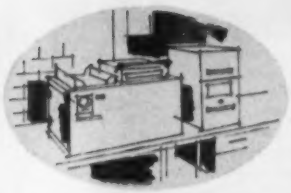

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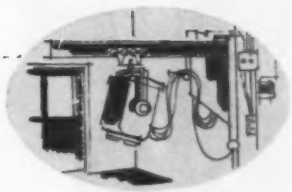

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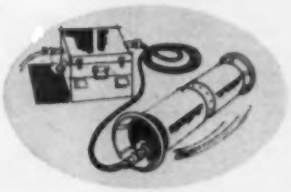

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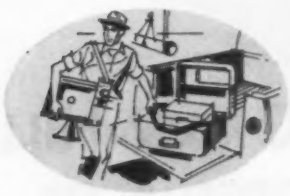

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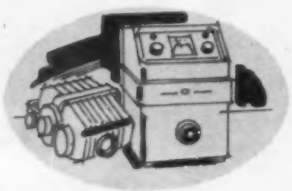

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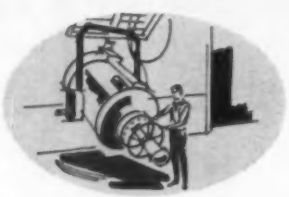

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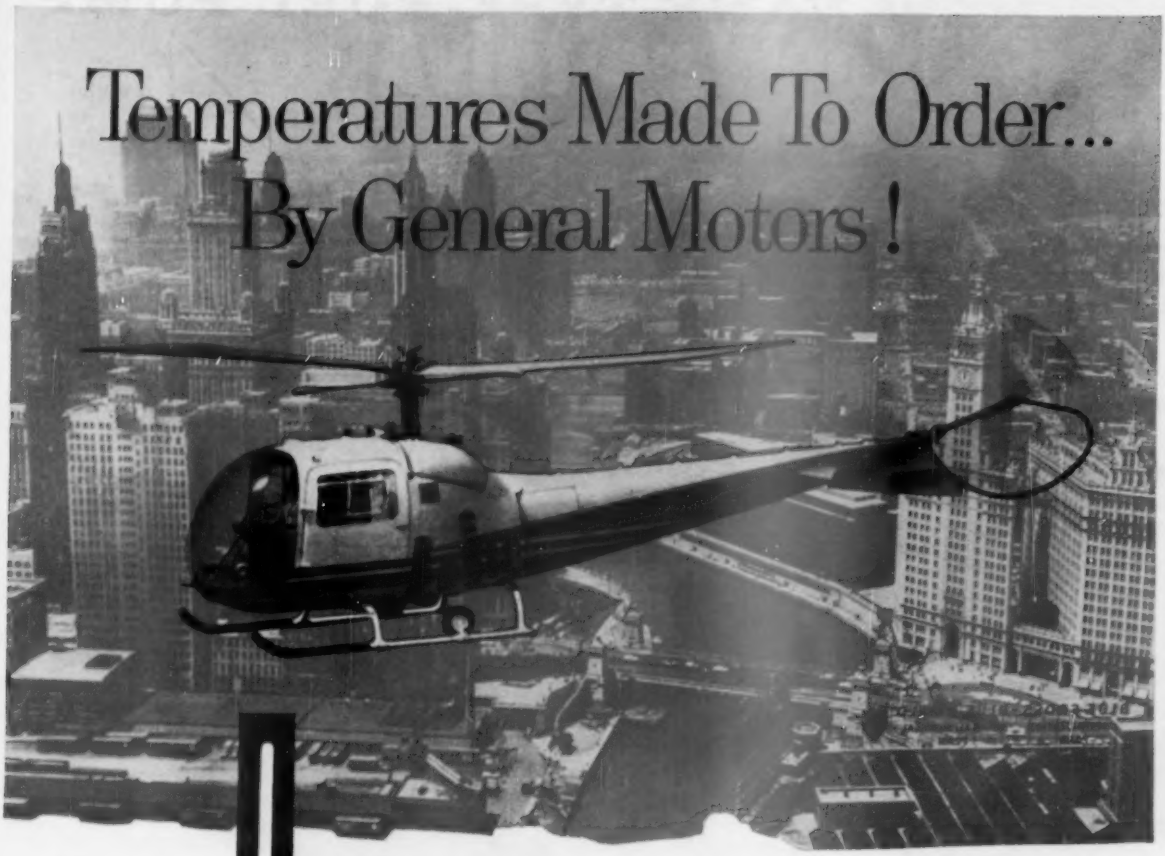

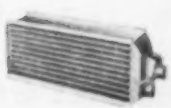

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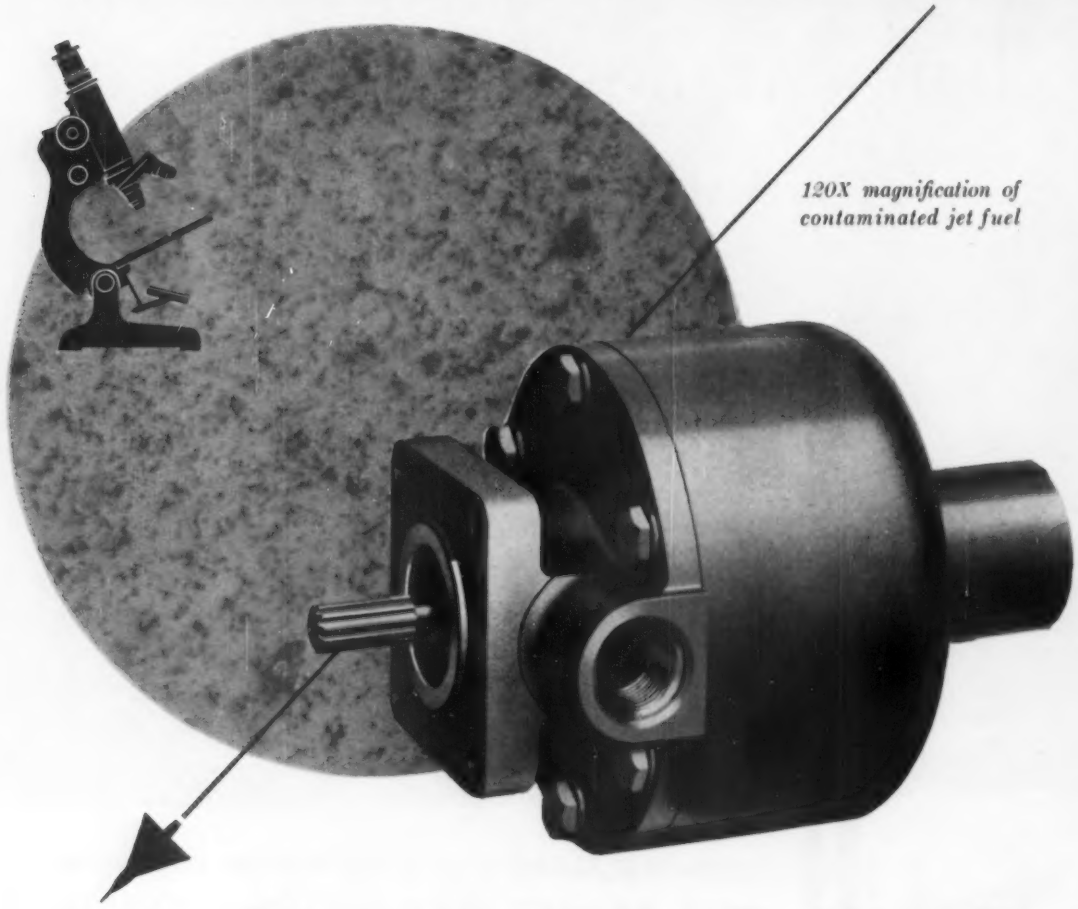

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Value of Bombardment Satellites Debated 26
▶ Defense and Air Force sponsor studies of concept; acceleration of space interceptor program expected.

CAB to Cancel Military Contract Bidding 39
▶ Defense warned it will have to pay standard rates; supplemental carriers oppose Board policy reversal.

Fan Burner Dominates Supersonic Designs 96
▶ Major engine companies concentrate large portion of advance design effort on fan burners to meet stringent performance needs.

SPACE TECHNOLOGY

Bombardment Satellites Debated.... 26
Satellites' Structures Research..... 28
Scout Variant to Have Dyna-Soar Role 54
Control Systems for Space Vehicles.. 67
Recovery System Would Slow Re-Entry 67

MISSILE ENGINEERING

Space Program Criticized..... 27
Snark Warhead Separation..... 29
Hypervelocity Gun Aids Wake Studies 128
Navy Homing Torpedo Production.... 129
Titan Underground Launcher Tested. 133

AERONAUTICAL ENGINEERING

First Nuclear Plane Details..... 30
Fan Burner Supersonic Designs..... 96
Ferranti Radar Fire Control System.. 107
Israel Orders 26 Mirage 3s..... 111
Cushioncraft Designed for River Travel 113
Rotary-Wing Booster Recovery Studied 119
Production Briefing 131

AVIONICS

Moving Globe Displays Pilot Position 69
Unit Speeds Weapon Control Test... 76
SNAP II Reactor Tested 77
Monitor Gives Pilot Audio Warning.. 79
Pilot Aid Designed For Auto Landings 83
New Avionic Products 84
Filter Center 93

SAFETY

Improper Recovery Cited in 707 Crash 159

AIR TRANSPORT

Military Contract Bidding 39
Faucett Seeks Peru-U. S. Route..... 40
Six Year Rate War..... 45
TWA Speeds Replacement Training... 47
Airline Income & Expenses—April... 48
Airline Officer Salaries Filed..... 49
CAB Approves Hughes-TWA Pact.... 49
Avro 748 First Flight Photos..... 118
Shortlines 52
Airline Observer 52

MANAGEMENT

Defense Terms Foreign Bases Essential 32
Convair Settles With Engineers..... 33
Congress Votes Defense Budget..... 34
Space Budget Passed..... 37
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 38

FINANCIAL

Financial Briefs 137
Mergers & Acquisitions 137
New Offerings 146
Navy Contracts 156
AMC Contracts 168

BUSINESS FLYING

Aero Design's 500A Shows Power Gain 148
Private Lines 155

Calendar 5
Letters 174

EDITORIAL

Supersonic Transport Race..... 21

COVER: Final adjustments to the dual payload of Navy's Transit II-A experimental navigation satellite are made at Cape Canaveral, Fla., prior to launch by a two-stage Air Force Thor-Able Star vehicle (AW July 4, p. 54). Bonus payload was first application of new technique for putting maximum payload weight into orbit (AW June 27, p. 26). Total payload weight of Transit II-A was 265 lb.

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The Lockheed-built Agena satellite—used by the U.S. Air Force in its Discoverer, Midas, and Samos programs—has been chosen for another major program. The National Aeronautics and Space Administration plans to use a larger, more powerful version, the Agena B. NASA will use both Atlas and Thor boosters to launch it. Atop the Atlas, the versatile Agena B will vary from a 5000-pound earth satellite to an 800-pound space vehicle. Atop the Thor, it will be used for a new series of 1500-pound meteorological satellites. Lockheed is prime contractor and system manager for the Agena and Agena B.

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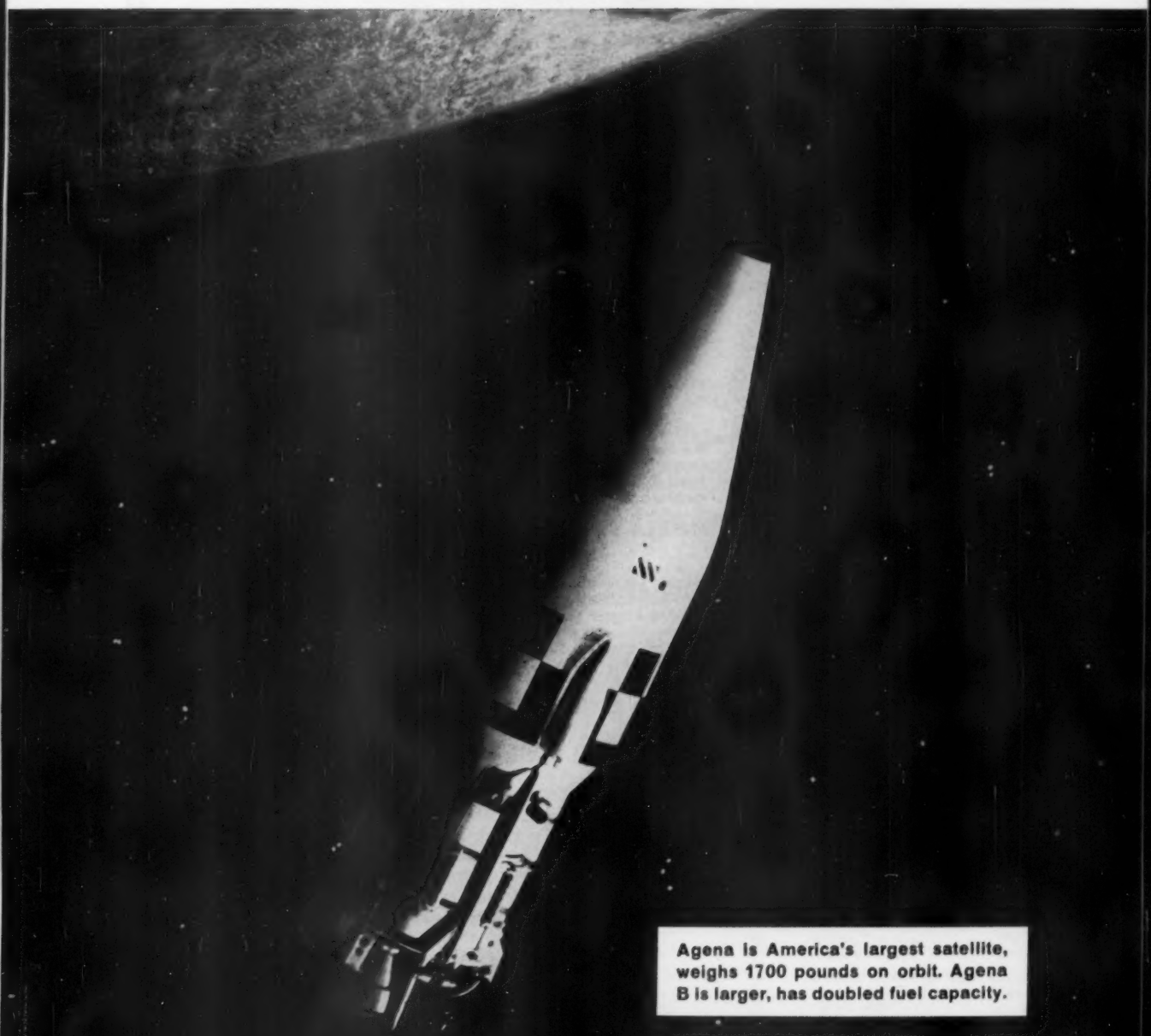

Agena is America's largest satellite, weighs 1700 pounds on orbit. Agena B is larger, has doubled fuel capacity.

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EDITORIAL

Supersonic Transport Race

The international spotlight is now focusing on the race to produce an efficient and airworthy supersonic transport, with 1960 looming as a year of decision for the entrants. Already the flags of France and the USSR have been run up as challengers for this aeronautical prize, and those of the United Kingdom and the United States should follow soon.

There is little debate over the international prestige that will accrue to the first successful contestant in the supersonic transport race. It will be a technical achievement in the eyes of the world comparable to the first satellite and the ICBM. But there is much more than international technical prestige at stake, although this country certainly would benefit greatly by regaining some of this prestige lost during the early Sputnik years.

Contrary to some opinions, we believe there will be a significant economic plum to be plucked by the first successful supersonic transport producer. The world market for such a vehicle will be substantial, but not nearly as large as the current and still expanding market for subsonic jet transports. The supersonic transport market is likely to provide a profitable enterprise for the first group solidly in the field with a vehicle that meets airline standards of economy and safety. The also-rans are likely to have rather slim pickings. The first flush of orders for any given nationality of supersonic transport is likely to chill enthusiasm for the other governments' financial support of their own projects as hopes for a good return on their investment fade.

The United States has led the world at almost every significant new technical stage in the development of modern air transport. Although it has not always been the first in the field with new types of equipment, it has generally proved to be the first in the international transport market with new types of equipment that solidly meet the airline operators' standards of safety and economy. Some of these achievements were possible only through the failure of international competitors who, though first in the market with new equipment, were unable to maintain the competitive pace.

The United States today leads the world in its knowledge of the art of supersonic flight. It has produced and is operating hundreds of supersonic military aircraft ranging from the original Century series of fighters barely pushing past Mach 1 to the Mach 2-plus bombers and fighters now in the air for USAF and the Navy. It would indeed be a tragedy if this backlog of supersonic knowledge were not properly focused on the problem of developing and producing a supersonic transport that would capture the world market for this type.

At present there is little evidence that the executive and administrative leadership required for this project is materializing. Almost every company in the air transport manufacturing business has done considerable research and preliminary design study on supersonic transports. The National Aeronautics and Space Administration is still, thanks to some hard pushing by E. R. "Pete" Quesada, Federal Aviation Agency administrator, and John Stack, the research dean of NASA's Langley laboratory, continuing research in the problem areas that loom for a supersonic transport.

The House Science and Astronautics Committee has tried to focus public attention on this project through its open hearings. As a group, it has strongly endorsed this endeavor. "Pete" Quesada has been working hard behind the scenes to interest the top level executive branch of the government in assuming leadership in the organization and initiation of this project as a national effort.

To date, there have been no significant results on the executive organization, leadership and financing of this project, although technical research and study are still continuing.

The hour is growing late in the international supersonic transport race for this type of executive decision. Regardless of the excellence of our technology in this area, it will avail little unless channeled toward significant goals and given the proper stimulus of a national effort.

There are many roads that could be pursued toward the goal of supersonic transports. For the prestige of being first in the field, a transport version of the Mach 2 Convair B-58 bomber could be quickly conjured into being. While it probably would not make an economic airline type transport, it would provide valuable operational experience in an area that is now a complete mystery to airline operators and would help to lay a sounder foundation for new transport designs. Some people have a mystical feeling that a supersonic transport will automatically result now that the B-70 Mach 3 bomber program appears to have regained its proper financial backing. But even the most enthusiastic North American engineers on the B-70 project would be the first to point out that while this project again would provide a valuable technical foundation for supersonic transports, this goal will not be achieved automatically or without further effort any more than the B-47 and B-52 bombers automatically produced the Boeing 707 jet transport series.

Even though it is now too late in the year for the necessary top level political decision to get this supersonic transport project vitalized, it is not too late for the industry and government organizations concerned to get together in serious conference and draw some firm blueprints for this program to be presented to the new political leadership as early as possible next year.

—Robert Hotz

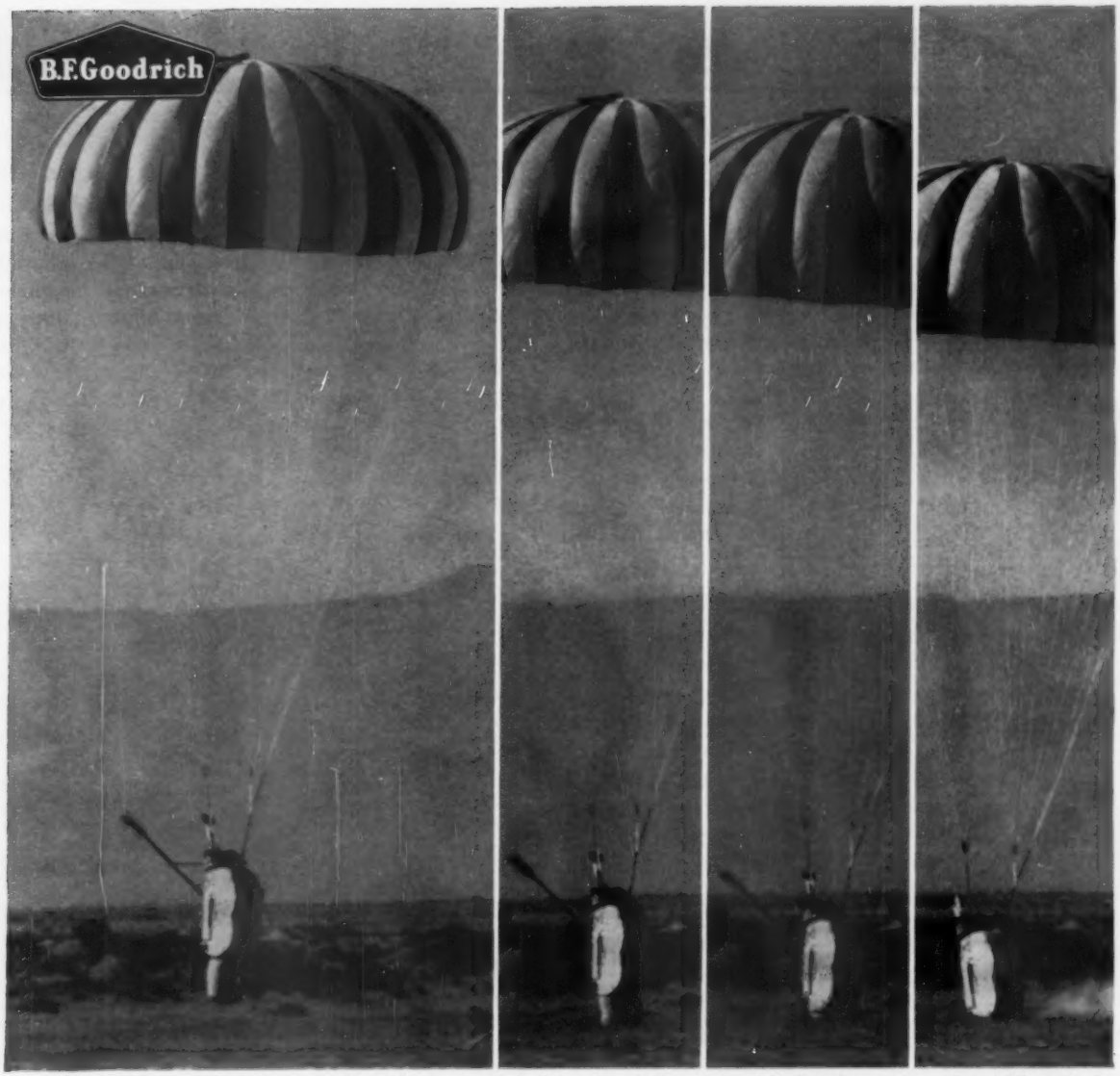

Photo sequence shows initial series of tests of B-70 escape capsule. In last photo note dust raised at right of capsule as air escapes through "blowout" valve.

Engineered "blowout" cushions landing

When this B-70 escape capsule hits the ground, the inflated rubber bag on the bottom absorbs initial impact—then the bag exhausts through a "blowout" valve just at the point of maximum compression to eliminate any bouncing "yo-yo" action. The bag must pack in minimum space, must inflate within 5 seconds.

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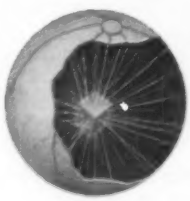

- Space vehicle payload landing
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WHO'S WHERE

In the Front Office

Frederick W. Hombruch, Jr., president and chief executive officer of Titeflex, Inc., Springfield, Mass., a subsidiary of Atlas Corp. Also: **Arthur M. Rogers**, treasurer.

Douglas F. Craig, a vice president, Coleman Engineering Company, Inc., Torrance, Calif. Mr. Craig continues as general manager of Coleman Engineering Division.

Dr. William A. Bain, vice president, Air Products, Inc., Allentown, Pa., and general manager of the Defense and Space Division.

Stanley S. Schneider, vice president-operations, Emerson Research Laboratories, Silver Spring, Md.

Joseph F. Degen, vice president and general manager, Weston Instruments Division of Daystrom, Inc., Newark, N. J. **Edward L. Klein** succeeds Mr. Degen as vice president-operations of the division.

Dale A. Lichty, vice president in charge of the Systems & Controls Group of Crane Co., Chicago, Ill.

Tenney Engineering, Inc., Union, N. J., has organized an Aerospace Division and has named **Dr. Bruno Sachs**, Tenney's vice president for engineering and manufacturing, head of the division; **Edward J. Flaherty** and **Jerome Perlstein** were named assistants.

Geoffrey W. Hall, chairman of Avions Fairey S.A., Gosselies, Belgium, succeeding **Richard Fairey**, retiring. Also: **Arthur Talbott**, managing director, succeeding **E. O. Tips**, retiring.

William E. Farrar, assistant to the vice president of Grand Central Rocket Co.'s Eastern Region, Washington, D. C.

John V. Tighe, special assistant to E. R. Quesada, Administrator of the Federal Aviation Agency, Washington, D. C. **Robert V. Reynolds** succeeds Mr. Tighe as special assistant to James T. Pyle, Deputy Administrator.

Col. H. L. Evans, deputy commander for space systems, Air Force Ballistic Missile Division, ARDC, Inglewood, Calif.

Honors and Elections

Grover Loening has been unanimously selected by the Daniel Guggenheim Medal Board of Award to receive the Daniel Guggenheim Award for 1960, which is bestowed to a "Pioneer, Engineer, Public Servant, for a lifetime devoted to the advancement of aeronautics in America."

USAF Capts. Joe B. Jordan and **Joseph W. Kittinger, Jr.**, both of ARDC, have been awarded the Harmon Trophy for 1960. Capt. Jordan won the Aviator's Award for setting a new altitude record of 103,395.5 ft. in a Lockheed F-104C, and simultaneously establishing the first time-to-climb mark to 30,000 meters of 15 min., 4.92 sec. Capt. Kittinger received the Aeronaut's Trophy for a record open-gondola ascent and parachute jump of 76,400 ft. in ARDC altitude escape research.

Reuben Lee, a consulting engineer at Westinghouse Electric Corp.'s Electronics Division, has received the company's highest award, the Order of Merit, for technical accomplishments including the development of the first radar pulse transformer.

(*Continued on page 170*)

INDUSTRY OBSERVER

► Army is contemplating a 750 to 1,200-mi. range version of the Martin Pershing surface-to-surface missile and has invited industry proposals for an inertial guidance system with accuracy required for the longer ranges.

► **Next step beyond Dyna-Soar orbital glider is a lift-type hypersonic space vehicle that can re-enter the atmosphere at super-orbital speeds up to escape velocity. NASA studies show that ablating heat shields will be mandatory. Vehicles must dissipate twice as much energy on return from a lunar mission as in re-entry from a low orbit. Dyna-Soar uses double wall metal structure surrounding insulating material. Super-orbital vehicle will have ablating outer skin, which should reduce guidance problem significantly by widening the altitude-speed corridor in which vehicle can fly.**

► Plan under consideration by National Aeronautics and Space Administration to launch Atlas Able VI toward the planet Venus next January has been shelved temporarily. Scheduled launching of Atlas Able V as a lunar orbiter has been pushed back from August to Sept. 22.

► **Contract awards for ground and airborne communications packages for Project Advent 24-hr. synchronous orbit, real-time repeater satellite (AW June 20, p. 85) are expected before Sept. 1. Army Signal Corps accepted bids through last Tuesday. Bidders are believed to include Aeronutronics, Airborne Instruments, Bendix, General Electric's light military and heavy military electronics departments, Hallamore, Hallicrafters, Hoffman, Hughes, International Telephone and Telegraph, Motorola, National, Philco, Radio Corp. of America, Raytheon, Sylvania, Texas Instruments, Western Electric and Westinghouse.**

► Development of a satellite interceptor under Project Saint is expected to be one of the first major programs undertaken by USAF's new Aerospace Corp. (AW June 27, p. 25).

► **Feasibility of a missile-borne radio communication relay is being investigated for Wright Air Development Division by Hughes Aircraft Co. in a series of Aerobee-Hi firings from Cape Canaveral, Fla. Two or three launches have been scrubbed so far because of equipment trouble. Relay could be used temporarily to link stations 3,000 mi. apart if they were interrupted by countermeasures or interference from ionizing radiation.**

► Coded signal for Army's Courier IA delayed repeater communications satellite will be changed at 600 sec. intervals by ground-based precision clock and tape mechanism to ensure exclusive command capability to trigger message transmission from orbit. Launching, scheduled for July 15 (AW July 4, p. 26), now has slipped to August.

► **Bendix Eagle air-to-air missile, under development for Navy's carrier-borne Missileer and other aircraft, is being projected to incorporate a closed-loop Freon refrigeration system to counteract effects of aerodynamic and solar heat. System will be bottle-fed, with refrigerant released at rate calculated to last for entire flight time of the carrying aircraft. Similar, larger system is under consideration for USAF-Douglas Skybolt air-launched ballistic missile.**

► Naval Ordnance Laboratory has developed a technique that should permit simulation of an explosion as large as the 20,000-ton Hiroshima atomic bomb with a charge of only 1,000 lb. of TNT. Blast wave generated when a small charge is fired in the apex of a cone represents sector of a spherical shock wave generated by a much larger charge fired in the open. Theoretical amplification is 160,000 to one, but even at 25% efficiency, a 2,000-ft. cone with an angle of about one-half a degree should simulate blast effect in air or water of a 20 KT bomb.

► **Large solar energy laboratory for investigation of extensive applications of this power source is being considered by Air Research and Development Command. It would be located at Air Force Missile Development Center, Holloman AFB, N. M.**

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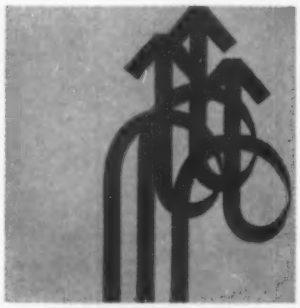
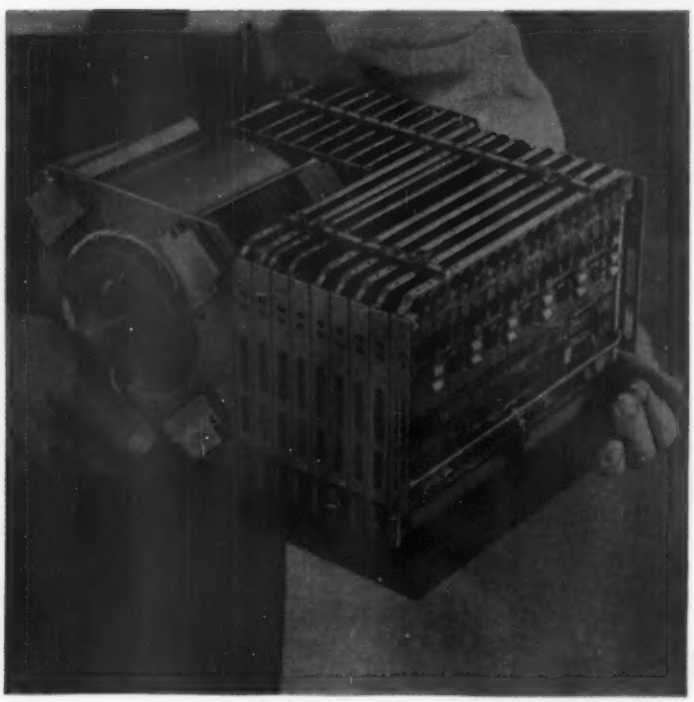


computers that pace man's expanding mind



GP LI-04

Washington Roundup

Atlas Base Probes

Air Force and Army were ordered last week to explain delays in getting Atlas bases operational. Four Atlas bases at Omaha, Neb., and Cheyenne, Wyo., are as much as six months behind schedule. Delays are blamed on labor problems and construction deficiencies.

Defense Secretary Thomas Gates asked USAF to prepare a report by the end of last week on status and construction quality of base work. Report was discussed at an Air Council meeting attended by Vice Chief of Staff Gen. Curtis E. LeMay, ARDC Commander Lt. Gen. Bernard A. Schriever and AMC Commander Gen. Samuel E. Anderson.

Criticism of the Corps of Engineers' role moved Army Secretary Wilber M. Brucker to investigate the situation. He ordered the Inspector General to look into charges of mismanagement so he could prepare a report for Gates. Brucker's action followed a request for information from Nebraska congressmen.

Watch for the Russians to bid for equal distribution of traffic on a Moscow-New York route in U.S.-Soviet bilateral negotiations. U.S. group headed by Edward A. Bolster, new director of the State Department office of transport and communication, will meet in Washington next week with a Soviet group led by Aeroflot chief Gen. Y. P. Loganov.

U.S. will resist the traffic-sharing move, and the talks probably will produce a Moscow-New York service operated under an agreement based on the Bermuda principles.

Senate Armed Services Preparedness Subcommittee staff also is looking into the Atlas base schedule slippage. It will not be able to report its findings until the Senate reconvenes Aug. 8 after the political conventions.

Senate got a list of mismanagement charges from ex-construction company employe Rex Breese when he quit his job last month in a protest move. Breese was assistant project engineer for George A. Fuller Co., consultants to the Corps of Engineers.

Budget System Defense

Franklin P. Lincoln, Defense Department comptroller, soft-pedaled the budget watchdogs' role in making defense policy last week at a meeting of the Defense Research and Engineering Policy Council. This was the first meeting of the group, which advises Defense Director of Research and Engineering Dr. Herbert York. Topics discussed included government laboratory competition with industry, military decisions made by scientists and basic research in the three services.

Lincoln argued that Defense comptrollers don't control military programs but merely inject the President's national fiscal policies into the total defense equation.

President Eisenhower followed the same theme last week, arguing that Democratic-controlled Congresses have generally supported his approach to defense policy. He noted that Congress has raised only three of the eight budgets he has submitted—all in election years.

The President disagreed with the contention of New York Governor Nelson Rockefeller that more money should be spent on defense. He conceded that Rockefeller is entitled to his opinion, but rejected the suggested spending increase.

Bomarc nuclear warhead control is the focus of a Canadian parliamentary controversy. Agreement for warhead control is under debate. It introduces the issue of nuclear weapons on Canadian soil at a time when public pressure is developing for a realistic disarmament plan.

Canada will insist on a launch veto as minimum terms in the agreement. Official Canadian position is that NATO nuclear weapons should remain in the hands of the U.S., Britain or France, but the government will insist on having a veto over their use from Canadian bases.

Air Force has realigned electronic support system operational responsibilities in a move highlighting the increasing importance of communications. Responsibility for all electronic support systems except communications has been shifted from the office of Director of Communications-Electronics, now called Directorate of Telecommunications, headed by Maj. Gen. Harold Grant to Director of Operations Maj. Gen. Samuel Agee. Both are under Deputy Chief of Staff for Operations.

Wrapup

Senate and House agreed on a compromise 20-mo. extension of supplemental airline operating authority pending a full investigation next year. . . . Controversial mutual security appropriation was left to be settled after Congress returns from the conventions. . . . House passed the bill banning transportation of surface mail by air, but the Senate is expected to block final action. **—Washington Staff**

Value of Bombardment Satellites Debated

Defense and Air Force sponsor studies of concept; acceleration of space interceptor program expected.

By Philip J. Klass

Washington—Feasibility and military usefulness of nuclear-armed bombardment satellites (NABS) have been the subject of several recent studies sponsored by Defense Department and the Air Force. Military planners are debating the worth of a system which would be similar to an ICBM nose cone which could be triggered to re-enter from orbit and strike a target area.

Concern over bombardment satellites, expected to accelerate the USAF's satellite interceptor program (Project Saint), has been sparked by several recent events. One was Soviet Premier Khrushchev's statement that the Russians have invented a "fantastic new weapon" which makes existing weapons obsolete. Soviet Maj. Gen. G. I. Pokrovsky mentioned the possibility of bombardment satellites in an article written nearly three years ago, just before launching of Sputnik I.

When U. S. recently proposed a ban on weapons of mass destruction in space, Soviet Union turned down the suggestion. This rejection could have been dictated by plans for bombardment satellites, although it probably stemmed from objections to international inspection of satellite launch sites.

Military planners will be debating two questions which are basic to the concept of a bombardment satellite:

- **Would it give the Soviets** sufficient military advantage over their present ballistic missiles to justify the drain of such a program on the Soviet economy?
- **Would it provide the** U. S. with sufficient additional deterrent and/or retaliatory capability beyond that obtainable from hardened missile sites and mobile land and underwater missile launchers to justify the cost of the program?

Those who favor the bombardment satellite as a weapon argue that it is nearly the ultimate in mobility and therefore in invulnerability. As a weapon in the U. S. arsenal, they argue that a bombardment satellite would be a powerful deterrent in its psychological impact.

Deterrent Effect

So long as bombers are the principal U. S. deterrent force, Strategic Air Command training flights, picked up on Soviet radars, serve as a continuous reminder of our retaliatory power—as evidenced by nervous Soviet protests over such flights in the past.

But when ballistic missiles, buried in underground silos or in the depths of the ocean, become the primary deterrent, NABS proponents ask how these missiles can make their presence felt. They believe a bombardment satellite, orbiting over a potential aggressor's homeland every few hours, would be a potent reminder of our retaliatory power.

Because a bombardment satellite is moving at orbital speed, it would be far less vulnerable to surprise attack than an earth-based missile site, NABS supporters claim.

Those who oppose the NABS concept take sharp issue with this contention. They say that within a few years, probably by 1970, it should be possible to knock down unfriendly satellites with a high degree of success. In fact, they argue that it should be easier to intercept and destroy a satellite in orbit than an earth-launched ballistic missile warhead because the element of surprise is eliminated.

'Easy to Intercept'

With a modest network of high-power radars, it is a relatively simple matter to locate satellites and establish their precise orbits. From this, it is possible to predict the satellite's future position, which greatly simplifies the task of interception by a counter-weapon, NABS opponents claim. Satellite interceptor studies, made under Air Force's Project Saint program, confirm this, they contend.

Those who oppose an active U. S. program in bombardment satellites and/or doubt whether the Soviets will find them an attractive weapon, base their views on these considerations:

- **Accuracy:** Fundamentally and inherently, the accuracy of a weapon launched from orbit could never be as accurate as that of an earth-launched ballistic missile against earth-based targets, because of the many additional sources of error in the orbital weapon. For example, the position of an earth-based missile site can be determined far more accurately than the position of a satellite in orbit. In a ballistic missile, inertial guidance gyroscopes need to maintain their position accurately for only three or four minutes, while gyros in a bombardment satellite, used to maintain retrorocket azimuth orientation, would have the accumulated error of many days, weeks or months in orbit.
- **Reliability:** A bombardment satellite could not be given a complete operational checkout while in orbit to assure that it would perform as planned when triggered, and component failures could not be repaired once the vehicle was in orbit as they can in an ICBM before launch. Thus, the number of bombardment satellites that would have to be placed in orbit would be several times the number of ICBMs required to accomplish any given mission.
- **Economics:** Because of this inferior accuracy and reliability, NABS opponents estimate that it would require at least five to 10 times as many bombardment satellites as ICBMs to achieve a given on-target striking force. Because a bombardment satellite with its command and control equipment would be larger and more complex than an ICBM warhead, and because a larger booster would be required to put the satellite into orbit than to put an ICBM warhead into a trajectory, NABS opponents contend that it would cost 10 to 20 times as much to build a strategic striking force of bombardment satellites as to build the equivalent force in ICBMs.

If these figures are correct, it would cost $100 billion to $200 billion for an all-out program to implement bombardment satellites, its critics claim.

- **Security and safety:** The triggering of bombardment satellites, which would bring them out of orbit, presumably would be accomplished by radio command. With several hundred or thousand such satellites in orbit, there always exists the possibility that a NABS might be accidentally or intentionally triggered by another nation, precipitating war prematurely insofar as an aggressor was concerned. Furthermore, until U. S. and Soviet space technology reaches the point where satellites can be put into desired orbits with 100% certainty, there is the possibility that a nation's bombardment satellite with its large nuclear warhead might fail to go into orbit and fall on friendly territory or on the launching nation itself. Since the satellite must be designed to withstand heat of re-entry for normal operation, it might not disintegrate before impacting. If it did disintegrate during re-entry, there still might be a problem of radioactive fallout.

As a weapon of aggression, the bombardment satellite defeats its very purpose by alerting a nation of impending attack, NABS critics claim. For example, if the Soviets suddenly placed several hundred or thousand unidentified satellites into orbit over a period of several days or weeks before the planned attack, many of them would be sure to be detected by U. S. radars. This would serve to alert the U. S. and possibly trigger a pre-emptive war.

If the Soviets were to spread out the satellite launchings over a period of many months or years, even a slow build-up of hundreds of Soviet satellites in space would still arouse suspicions and alert the nation as the build-up continued. If the Soviets used such a gradual build-up, extending over a period of many months, this would increase the possibility of accidental triggering of a satellite and the risk of precipitating war prematurely.

In any event, Soviet use of bombardment satellites as a major force of attack would provide the U. S. with far more alert and warning time than it could ever hope for against ICBMs, even with the Ballistic Missile Early Warning System and Midas early warning satellites, NABS critics contend.

Critics of the bombardment satellite claim that the weapon is vulnerable to peace-time counter-action. In the present cold-war environment, a nation equipped with satellite interceptors probably could knock down a suspicious satellite flying over its territory without great risk of starting an all-out war, whereas it could not attempt to knock out another nation's ICBMs in peacetime without precipitating war.

In fact, NABS critics contend, it should be possible in another decade for the U. S. to knock down Soviet satellites almost as fast as they can be put up, and the Soviets probably would have the same capability for satellite destruction by that time.

For this reason, NABS critics claim that hardened underground missile sites, mobile launchers and Polaris submarines give the U. S. retaliatory force far greater security, at far less cost, than could be achieved with bombardment satellites.

Some proponents of the bombardment satellite concede that it cannot compete with ballistic missiles if the satellite is armed with a "conventional" thermonuclear warhead. But if they were armed with cobalt bombs, a handfull of satellites would have the capability of destroying life on an entire continent by radioactive fallout. No nation would risk the launching of war if it knew its enemy had a few such super-bombs in orbit which would be triggered by aggression.

Critics of the bombardment satellite concede that such a weapon would ease the problems of numbers and economics, but they point out that it would greatly increase the risk in launch and of accidental triggering.

The deterrent effect of super-bomb-carrying satellites, they point out, depends upon making public the existence of such a weapon. The risk of accidental triggering, however small, which could wipe out sizable portions of the earth's population and would mobilize world opinion against the use of such a weapon, NABS critics contend.

NASA's 10 Year Space Program Criticized by House Committee

By Ford Eastman

Washington – National Aeronautics and Space Administration's 10 year space exploration program does not go far enough or fast enough, the House Committee of Science and Astronautics charged last week.

The committee specifically criticized NASA's program for the utilization of a nuclear rocket powerplant and the development of the 1.5 million lb. thrust single chamber F-1 engine. In addition, the committee said most of its members also felt that Project Saturn, the 1.5 million lb. thrust clustered engine booster, Project Mercury man-in-space program and plans for a manned lunar expedition had not been pushed with a "sense of urgency."

At the same time, the report criticized NASA for refusing to take over Project Orion, a system of space propulsion in which a series of small nuclear explosions can launch large vehicles or platforms into space.

The committee also recommended a bigger Navy space effort. Noting that the Navy foresees no need for super-boosters or a man-in-space program, the report said that in view of their probable application to naval warfare, "as well as the long lead times required, not only for their technical development but for their evolution as operational systems, it would seem wise to begin work on them now."

The House group forecast a need for a manned, sea-based space system to intercept other space vehicles and said super-boosters will be required for this and several other space missions.

The report, based on extensive hearings earlier in this year, made these recommendations:

- **F-1 development program** should be expedited in line with other priorities to make a 1.5 million lb. thrust, single chamber rocket engine available as soon as possible to supply a backup powerplant to the Saturn. F-1 also will provide "the opportunity to cluster engines to higher levels of thrust as a follow-on to Saturn." This is the Nova cluster.
- **Before substantial funds** are committed on the Nova concept, NASA should determine whether a nuclear engine, either by itself or in combination with the more conventional engines now in use or contemplated, offers "a faster and more economical method of achieving a breakthrough that would enable the United States to leap-frog the Soviet Union in the field of space propulsion."
- **High priority program** should be undertaken to put a manned expedition on the moon in this decade. "A firm plan with this goal in view should be drawn up and submitted to the Congress by NASA. Such a plan, however, should be completely integrated with other goals, to minimize total costs. The modular construction approach deserves close study. Particular attention should be paid immediately to long lead time phases of such a program."
- **Project Orion** should be shifted to NASA by the end of next month. "The committee is happy to learn that the Air Force, which has been in active control of the program, plans to continue Project Orion by transferring from another project the $1 million to $2 million required to continue it for the 1961 fiscal year. However, the Committee feels that this is the type of project that should be administered by NASA, recommends that it be turned over to the civilian space agency."

Lack of funds and top priority has delayed the F-1 engine program from 12 to 18 months, the report said, pointing out that the National Aeronautics and Space Council turned down a request in December, 1958, for a DX priority for the F-1 and as a result, development later was held up due to lack of steel during the steel strike. The report also said witnesses testified that due to cuts made by Congress last year in funds for the program, development was further delayed, and it may take as long as five and a half years to complete instead of the 42 to 48 months previously contemplated.

NASA's 10-year program makes no provision for getting a manned expedition to the moon, other than the forecast that a manned landing on the moon may take place in the time period beyond 1970, the report said, pointing out that witnesses appearing before the committee testified that manned exploration of the moon is possible by 1968 or as early as 1965 if pushed hard.

Satellites Urged for Structures Research

By J. S. Butz

Washington—Development of recoverable satellite laboratories for testing structures and materials in space has been given the highest priority among a long list of urgent structural problems by the National Aeronautics and Space Administration's Research Advisory Committee on Structural Design.

Almost the same emphasis was placed by the committee on the need for ground-based test facilities that would match the space environment as nearly as possible. Both the satellite laboratories and ground facilities are considered necessary for the accumulation of realistic engineering design data for space vehicles.

Recommendations of the advisory committee are aimed at clearly defining and assigning priorities to the areas in which emphasis is needed in structural research and development for advanced aircraft and missiles as well as space vehicles. The recommendations are so extensive and inter-related that it will be many years before they can all be realized.

Purpose of the report is to provide guidelines for NASA operational groups in their budget planning and management over the next few years. The committee's conclusions and a general review of its work has been published as NASA Technical Note D-518, entitled "Important Research Problems in Advanced Flight Structures Design—1960."

Recoverable satellite laboratories needed for structural and materials testing will have some form of collapsible sides or extensible arms so that specimens with large exposure areas can be subjected to the space environment. The specimens would be instrumented so that transient data regarding their condition could be telemetered to the ground. Finally at the end of the test, the specimens could be retracted behind the heat shield and the satellite could be returned to the earth without the heat of re-entry damaging specimens or instrumentation.

Ground laboratories used to complement the test data from space would have these four major requirements:

- **Hard vacuum to reproduce** the surface phenomena encountered in space with most materials and finishes.
- **Heating and cooling** that reproduce the heating of sunlight and the cooling of shadow areas in space.
- **Hypervelocity "guns"** to simulate the impact of meteoroids at velocities considerably higher than 20,000 fps.
- **Proton accelerators** to provide 400 Mev particles in reasonable fluxes in a chamber large enough to allow the accurate study of the shielding systems.

The advisory committee recommended immediate implementation of a recoverable structures test satellite program and heavy expenditures for the design and construction of the ground facilities. Recoverable satellites specifically for structures and materials test are not included in the Fiscal 1961 budget, and only small funding has been provided during that period for ground test facilities of the type recommended by the committee.

The committee included two general classes of problems in the "very high priority class," which ranked below the problems discussed above. These relate to the design of pressure vessels and to the development of materials and techniques for containing cryogenic fuels.

Pressure vessels, which will be the main structural elements in space vehicles, cannot be designed properly until better environmental information is obtained through satellite studies. One of the major environmental unknowns today is the frequency and penetrating power of various classes of meteorites. The committee also describes the present knowledge of pressure vessel design as inadequate and recommends that a broad basic research program be implemented in this field to study:

- **Crack propagation** which is not properly understood for aircraft structures and has been investigated only on a limited basis in space vehicle type structures, where the stress level will be much higher and the stress distribution much different.
- **Fail-safe design** on an elementary basis so that concrete design criteria can be spelled out in detail.
- **Possible configurations** on a detailed parametric basis so that optimum designs can be identified for missions.
- **Multi-wall pressure vessels** with special emphasis on stress distribution, design and meteorite stopping capacity.

Even though the containment of cryogenic materials has been accomplished in the laboratory for long periods, the committee foresees considerable difficulty in extending this capability to flight structures. Four main areas for research listed by the committee are:

- **Development of filamental** flattened fiber and bonded-foil composite.
- **Development of methods** for easy attachment of bulkheads, nozzles and other discontinuities into pressure vessels made of filamental materials.
- **Development of methods** for the inspection of non-metallic materials.
- **Development of structural** and insulation materials for cryogenic tanks, not susceptible to brittle fracture and with low thermal conductivities.

"High priority" classification was given to a number of other problems by the committee. The two placed at the top of this list were the study of structural fatigue and the problem of shielding biological payloads from the ionizing radiation in space.

The committee reports that no method exists or is in prospect which will allow the satisfactory prediction of fatigue life for any structure. It recommends that the search for such a method be intensified, even though great effort is already being applied to it.

The goal of the shielding study is to integrate the shielding necessary for biological payloads with the structure of the space vehicle as much as possible. One of the first requirements of this study is to determine what the shielding requirements will be for the various missions even by an order of magnitude.

Dyna-Soar Research

Washington—Air Force has awarded two preliminary design contracts for large scale free-flight models of Dyna-Soar type hypersonic vehicles.

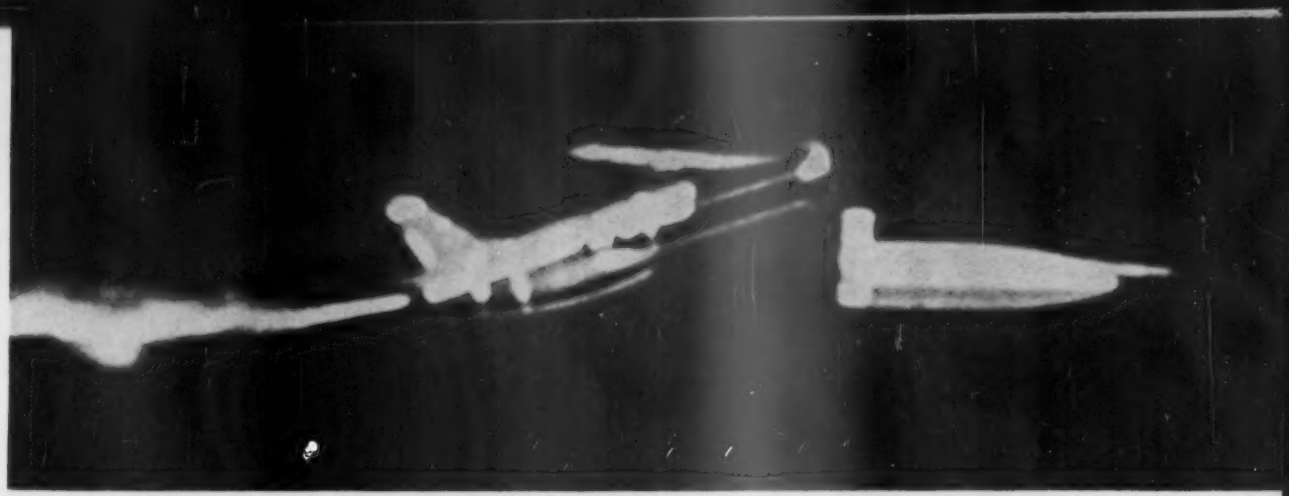
They are scheduled to be ready for flight in 12 months. Actual flight dates of the Mach 20 models will depend on availability of the TS-609A solid propellant booster vehicles.

One contract, covering two aerodynamic models, was won by Flight Sciences Laboratory of Buffalo, N. Y. McDonnell Aircraft Corp. was awarded the other contract, covering design of three structures models.

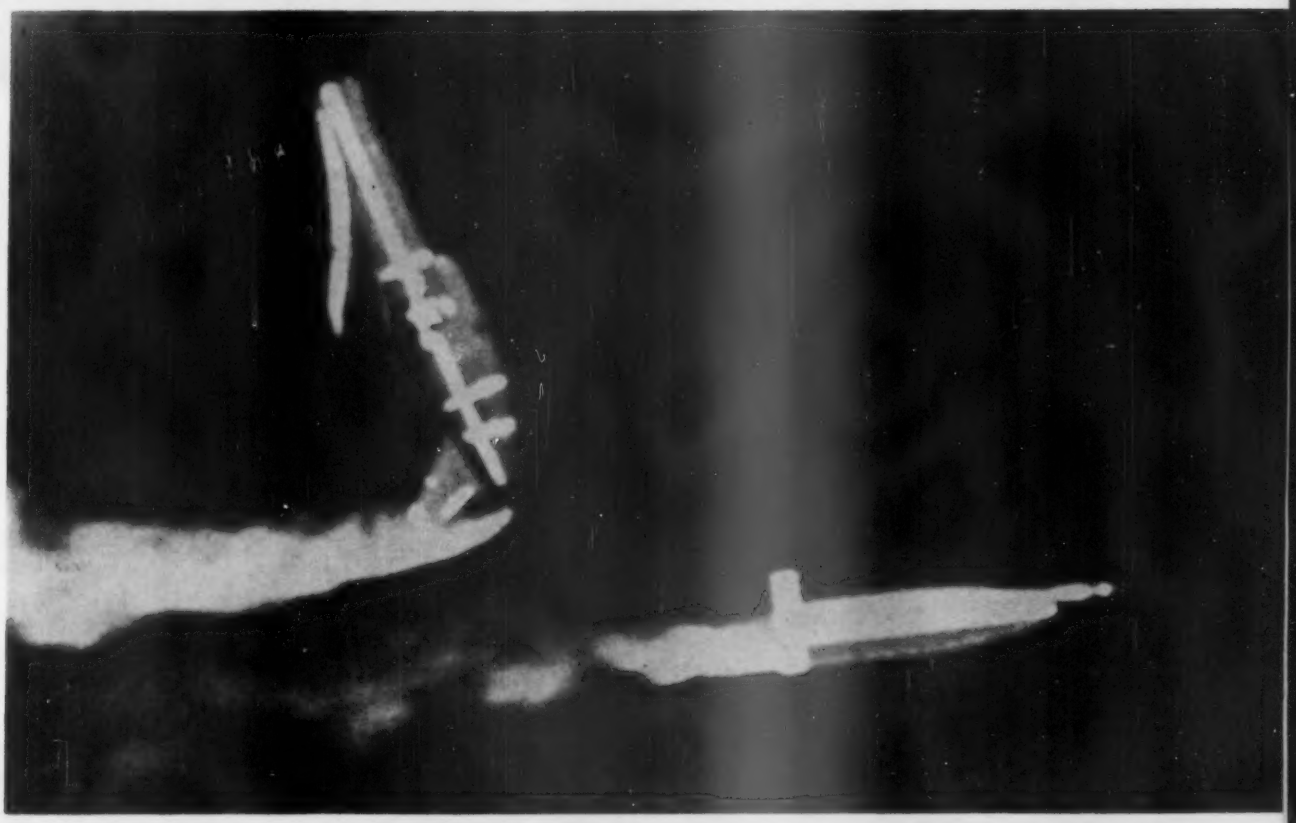
The aerodynamic models will provide the first large scale data on forces, moments, heating and pressure distributions ever taken, either in wind tunnels or free flight, at high-hypersonic speeds. Data will be telemetered and models probably will not be recovered. The current Flight Sciences Laboratory studies will fix the model scale. It may be as large as one-fourth the size of the Dyna-Soar.

Main purpose of the structures models is to test full-scale structural parts over the speed range of the Dyna-Soar. Several different types of structures will be tested on each flight and the model configuration will be adjusted so that the full-scale test elements will be subjected to the same load they would experience on a man-carrying vehicle.

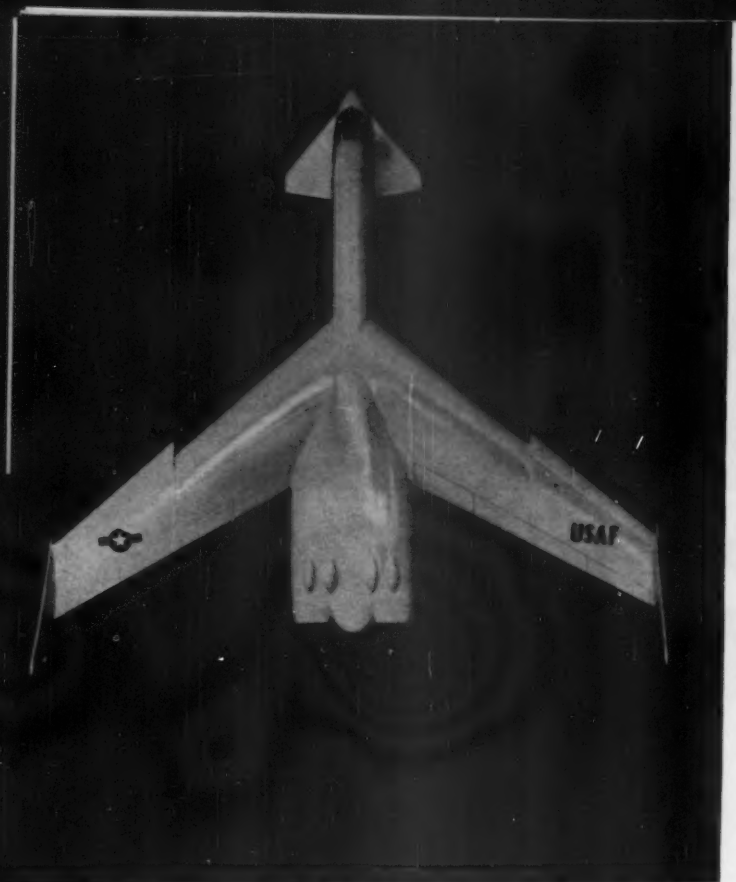
There are several phases in the model development and flight test program beyond the current preliminary design phase, on which 15 companies entered bids. Contractors for other phases will be selected later.



First Photos Show Separation of Snark Warhead



First photos of separation of USAF-Northrop SM-62 Snark's 5,000 lb. nose show how warhead is detached from the missile to fly to target on its own momentum. Aerodynamic drag immediately causes main body of the missile to pitch upward and destroy itself. Separation is programed into missile, which uses stellar-inertial guidance system and is not under command when it nears target. Snark is powered by Pratt & Whitney J57 jet engine, has a range above 5,000 mi. Snarks are operational with 702nd Strategic Missile Wing at Presque Isle AFB, Me. Photos are from motion picture film made some time ago in test flight over Atlantic Missile Range.

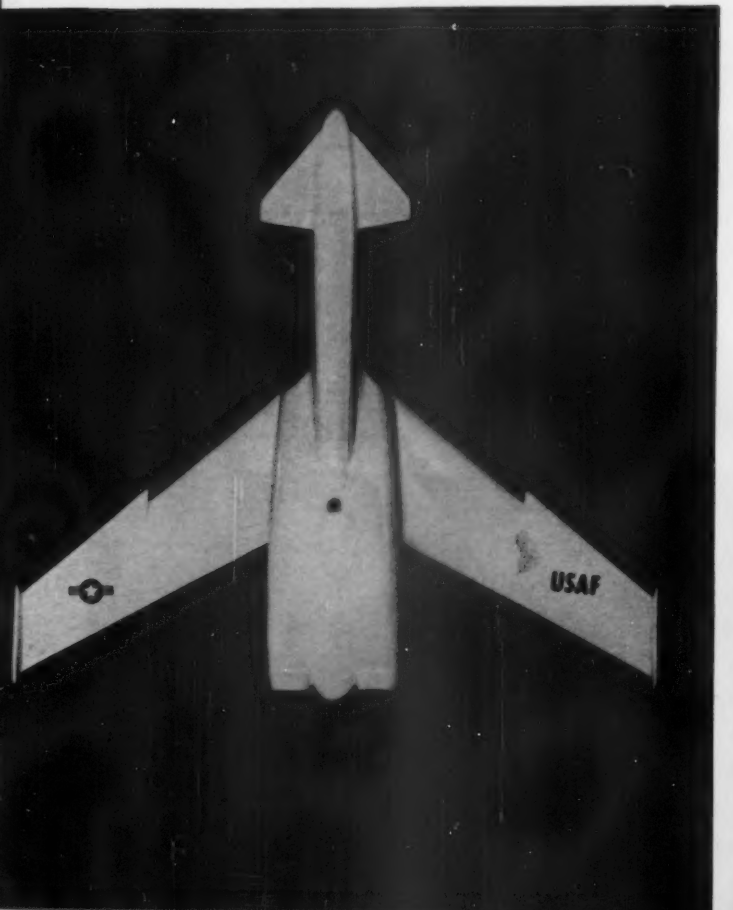


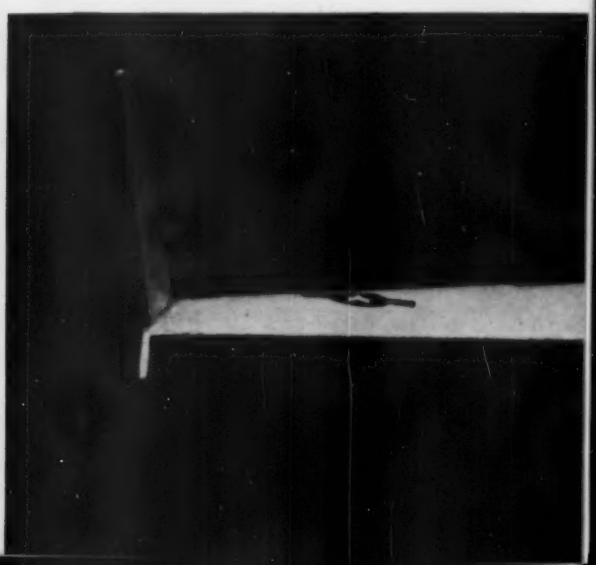
Canard configuration was chosen for the first nuclear-powered aircraft because it allowed the crew's compartment to be located a maximum distance (over 100 ft.) from the reactor and the aircraft's center of gravity.

Air Force's first nuclear-powered aircraft will be a subsonic test

First Nuclear Plane Details Shown in Convair Design

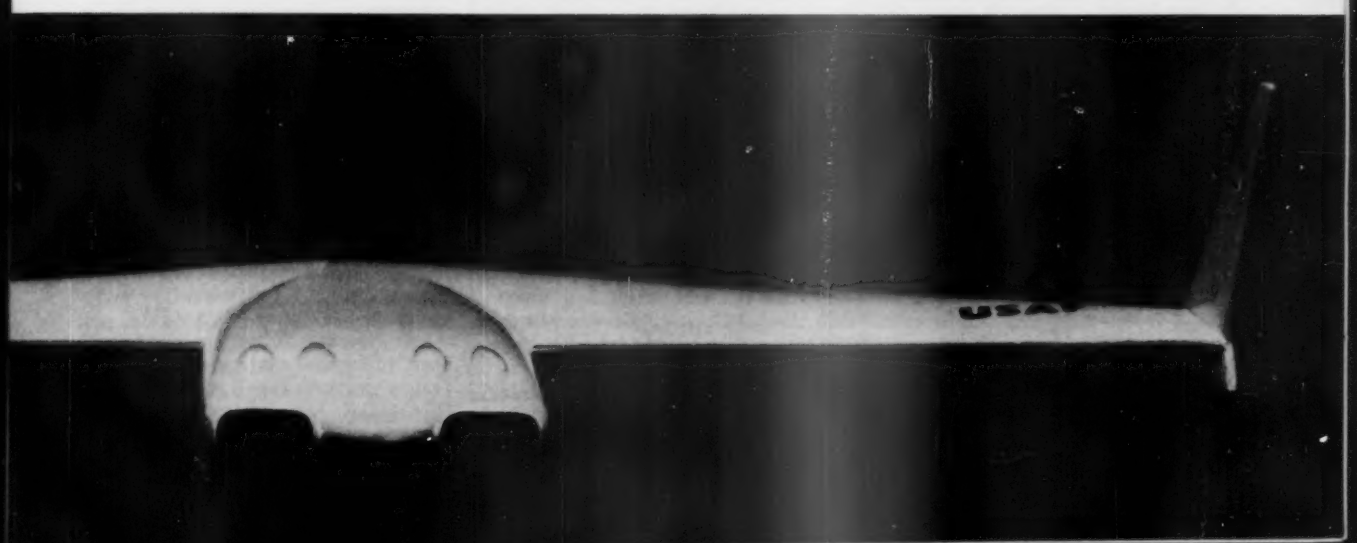
First U. S. nuclear-powered aircraft, to be built for the Air Force by Convair-Ft. Worth, will have a subsonic, canard configuration and will be about the same size as late-model B-52s, weighing around 450,000 lb. Model on these pages shows the general arrangement of the aircraft, which can accommodate either General Electric direct-cycle or Pratt & Whitney indirect-cycle nuclear engines without major modification. Present Air Force schedule calls for airframe construction to begin in 12 to 18 months and for extensive flight tests using conventional engines with hydrocarbon fuels before the first flight on nuclear power late in 1965. This schedule is based on continuation of the current expenditure rate of about $150 million per year and no major, unforeseen technical difficulties.





bed to explore the entire nuclear aircraft concept and to aid in the establishment of requirements for operational systems.

Two exhaust nozzles (below) are planned for the four nuclear turbojets to be used in the Convair nuclear aircraft testbed.



Defense Terms Foreign Bases Essential

By Edward H. Kolcum

Washington – Defense Department plans to maintain its network of overseas military bases as a bulwark against brush fire wars despite the agitation against these bases that has been heightened recently by the U-2 incident and subsequent diplomatic events.

With the advent of intercontinental range ballistic missiles and longer range bombers, U. S. strategic forces will have a diminishing reliance on overseas bases. But the Air Force, Navy and Army all maintain that any mass closing of foreign bases would cripple the existing capability to contain local war and permit Communist forces to fill the resulting military vacuum.

Foreign protests against overseas U. S. bases, continually cultivated by Communist propagandists, have grown in the wake of the May 1 crash of a U-2 near Sverdlovsk, USSR, and of Soviet threats against any nation that permits U. S. reconnaissance operations from its soil. Riots against the U. S.-Japanese security pact, which forced cancellation of President Eisenhower's visit to Tokyo, were the most striking demonstration of the pressure the U. S. feels against its military operations on foreign bases.

Reluctance in many areas to supply new sites for U. S. operations has hampered negotiation of tracking bases for the world-wide Project Mercury network.

The U-2 incident, coupled with rising nationalism in Africa, did nothing to ease tracking problems of the National Aeronautics and Space Administration. Identification of NASA as "cover" for military reconnaissance flights effectively opened to question the agency's frequent statements that it is a civilian scientific organization pursuing peaceful exploration of space.

Agitation against a Mercury base in Mexico developed after the U-2 crashed. More recently, African nationalists have announced plans to demonstrate for removal of the Mercury base from Zanzibar, a British protectorate until it becomes independent in October. Mercury base pacts with Zanzibar and Nigeria are the only two remaining to be signed to complete the network.

Earlier, these same African nationalists demonstrated against the establishment of a tracking base for the Courier communications satellite. Plans for the Courier base have been canceled. Protests also flared in Indonesia after Adm. Arleigh Burke, Chief of Naval Operations, was reported to have said the U. S. is interested in a base in Dutch New Guinea. Indonesia claims this territory.

Defense Department earlier had decided not to install telemetry antennas for Samos and Midas satellites in countries near Russia because of uneasiness in these nations stemming from the U-2 incident (AW July 4, p. 25).

Debate on the validity of foreign bases has forced the services to review alternatives. Defense planners have concluded that collective security alliances, with base rights, remain the best defense against Communist bloc expansion. They also feel that the present forward base strategy is strategically sound as long as there is a threat of local war involving allied nations along the Communist bloc periphery which are not strong enough to meet the threat alone.

Air Force and Navy say they can live without overseas bases, but a widespread cutback will hamper response time and add logistics complications.

USAF says it probably would feel the lack of bases less than the other services because Tactical Air Command's strike force could be flown from the U. S. to any country in a matter of hours. But Air Force stresses a requirement for overseas operational bases around Soviet periphery, even if these bases are not permanently manned by U. S. forces. USAF has 12 fighter bases in Japan, seven in Korea, two in Okinawa and one each in the Philippines and Formosa. If these forces had withdrawn, bases could be built and maintained with U. S. funds and kept on a standby status until required.

The trend in Strategic Air Command operations is to reduce overseas base reliance as B-52s replace shorter range B-47s. Overseas bases for strategic air operations are maintained principally as recovery bases for crippled aircraft and for U. S.-based B-47s rotated overseas on ground alert under the Reflex program (AW June 20, p. 116).

As strongest proponent of the concept of forward strategy, the Army considers its overseas installations abso-

U-2 Repercussions Continue

Washington—Downing of a U. S. Lockheed U-2 reconnaissance aircraft in Russia May 1 continued to cause diplomatic and political repercussions last week.

Soviet Premier Nikita Khrushchev told the Austro-Soviet Society in Vienna, Austria, that U. S. reconnaissance planes still are deployed at overseas bases and are ready to resume spy flights over his country. He said "Washington has never had to suffer such humiliation" as that caused around the world by the U-2 incident, and he said Austria was "lucky to have escaped being turned into an American base."

British Prime Minister Harold Macmillan defended himself in the House of Commons against the charge that he was not "playing honest" in a discussion of whether Britain had control over spy flights of U-2s from English bases.

The discussion in Parliament followed the loss on July 1 of a Strategic Air Command RB-47 in the Barents Sea, 275 mi. north of Russia's Kola Peninsula, on a flight from Brize Norton airfield in England. USAF said the plane was making an "electromagnetic survey" over Arctic waters, and Assistant Secretary of Defense for Public Affairs Murray Snyder said that if the plane had flown over Soviet territory, "it was not deliberate." Late last week, no trace of the plane or its six-man crew had been found.

The Sudanese government last week denied a report made by the United Arab Republic radio that an American U-2 made an emergency landing at the Khartoum Airport on July 2 because of engine trouble and then flew on to Nairobi, Kenya, after repairs.

House of Commons debate arose after Macmillan said there has been a satisfactory agreement since 1951 providing for joint Anglo-American control over use of British bases by U. S. aircraft in emergencies. He said the question whether U. S. reconnaissance flights over Russia are emergencies "depends on the circumstances." Macmillan refused an immediate answer without reflection to Labor Party questions whether U-2 flights were approved before May 1, whether a protest had been made if flights were made without approval and whether Britain could forbid use of bases for activities of "a provocative or risky character." Labor foreign affairs spokesman Denis Healy said Macmillan was not prepared to "play honest" with the issue.

U-2s operated by Strategic Air Command and Air Research and Development Command are still flying, Air Force said last week, but not outside the Western Hemisphere. Three SAC U-2s which had been based at Ezieza International Airport near Buenos Aires, Argentina, completed their phase of Operation Crowfoot—detection of radiation in the atmosphere over the Southern Hemisphere—and returned to Laughlin AFB, Tex., on June 5-6, USAF said.

Cuban Threat

Washington—Navy believes the Cuban government under Premier Fidel Castro is the greatest immediate hazard to its base system and plans to use force to defend its legal right to the Guantanamo Bay base.

Navy insists it will not provoke a showdown in Cuba, but it is prepared to defend the base. Guantanamo Bay is considered essential for control of Caribbean sea lanes and approaches to the Panama Canal. The bay area is used for shakedown operations for all ships coming from East Coast shipyards.

lutely essential. Withdrawal from any key base means immediate loss of controlled operational communications, plus the need to retake the base when action begins, Army said.

Army believes its presence overseas extends beyond meeting military commitments into political and economic areas, arguing that U.S. forces serving with North Atlantic Treaty Organization and the United Nations give small nations the will to resist internal Communist pressures as well as offering the principal deterrent to local war.

Major Installations

Army has 24 major overseas installations, 13 in Europe, eight in the Far East and three in the Caribbean area.

Both Air Force and Army say they recognize that foreign installations are unnatural and in normal times would not be tolerated because of the universal desire for national integrity. With the current cold war situation, however, they say bases must be maintained until smaller nations become strong enough by themselves or in alliances with neighbors to contain communism.

Navy's base complex is smaller in number and involves less direct contact with foreign nationals than USAF and Army bases. Navy contends that in a large-scale loss of bases, its seagoing mobility gives it the paramount role in local war since it can operate at all ocean borders with strike aircraft and Marine ground forces. Most of the Seventh Fleet in the Far East is always at sea, resupplied by mobile service force elements.

Although the Seventh Fleet can operate without foreign bases, loss of either the vast Yokosuka complex in Japan or the Subic Bay base in the Philippines would be considered a serious reversal by the Navy.

Yokosuka is considered the Pacific Fleet's northern anchor and Subic Bay the southern anchor in Far East operations. Both have extensive repair facilities to accommodate attack and antisubmarine carriers as well as other ships. Fuel oil for three months of operation is stored at dispersed points in Japan.

Okinawa is important to the Navy because it is the base for two-thirds of the Third Marine Division, the ready Marine force in the Pacific.

Navy and Marine air stations in Far East are Atsugi and Iwakuni in Japan.

Base loss to the Navy would result in withdrawing first to the Philippines and then to Guam. Guam is the westernmost U.S. possession and would be built up to compensate for repair and supply facilities lost in Japan.

With strong service support for retention of overseas bases, it is unlikely that Defense Department will scrap the 13-year-old policy under which they are operated. Defense Secretary Thomas S. Gates said last month that strategic usefulness and political problems created by individual bases is under continual review. Apparently such review resulted in the plan to remove tactical units from Johnson AFB near Tokyo next December. Gates said as a matter of policy, however, U.S. will maintain deployed forces in the forward strategy.

Convair Settles With Engineers; Industry Negotiations Continue

Tentative agreement on a one-year contract covering more than 6,000 members of the Engineers & Architect's Assn. at Convair's San Diego facility was reached last week, although elsewhere in the industry talks continued in efforts to avert and end strikes.

New contract, subject to ratification, calls for a 3% pay increase for 4,700 salaried workers and a raise of four cents an hour for 1,500 hourly employes, retroactive to June 6. For hourly workers, the contract also freezes five cents of accumulated cost of living adjustments into base pay rates.

Other benefits include layoff payments of up to $50 for each year of service, increases in retirement payments and business travel per diem rates, and a raise in life insurance benefits from $500 to $1,000 for all employes in the bargaining unit.

West Coast Developments

In other West Coast developments, negotiations continued at Rohr Aircraft Corp. where 6,000 employes at Chula Vista and Riverside, Calif., have authorized a strike. Contract with the International Assn. of Machinists expired July 9.

Meetings resumed between Lockheed Missiles and Space Division and the IAM bargaining unit for 4,600 members. Strike has been under way for three weeks and talks were recessed by a federal mediator after a breakdown over job classification and security (AW July 4, p. 37). Facilities involved are at Sunnyvale, Santa Cruz, Van Nuys, and Vandenberg AFB, Calif.

At Ft. Worth, Tex., the Office Employes International Union reached agreement with Convair on a contract involving 2,600 employes, of which about 1,500 are represented by the union. Pay increase is four cents an hour in the first year of a two-year period, and an additional three cents in hour in the second year. A five cent cost of living adjustment was added into the base wage rate.

Employes also now are eligible for a new program of extended layoff benefits providing $50 for every year of service. Other benefits include a raise of $1.75 to $2 per month in retirement benefits for each year of service, and life insurance benefits for retired employes were increased from $500 to $1,000.

Negotiations at Convair-Ft. Worth are continuing with the IAM, the International Brotherhood of Electrical Workers and the Federated Independent Texas Unions.

At Hurst, Tex., two United Auto Workers locals (production and office workers) walked off the job at Bell Helicopter last Tuesday and returned the next day, following hit-and-run tactics used earlier.

Union later requested a reopening of negotiations.

At Chance Vought, the United Auto Workers and management reportedly had agreed on a new contract, replacing a pact which expired last Mar. 17.

Authorization Failure

The IAM at Boeing Airplane Co. facilities at Seattle, Wash., and Wichita, Kan., failed to get strike authorization when the voting did not reach the required 75% approval of those attending the union meeting. Company and union were to meet with federal mediators last week.

Meanwhile, negotiations continued between United Aircraft and the IAM and UAW on contracts involving employes in seven struck Connecticut plants. United said 17,000 production workers were on the job late last week, of a total of 30,000. Pickets are still on duty.

Workers who returned are working a minimum of 10 hr. per day and a full Saturday shift. Company claims that on this man-hour basis, over-all production is 75% of normal.

Congress Votes $39.9 Billion for Defense

By Katherine Johnsen

Washington—The $39.9 billion Fiscal 1961 defense budget voted by Congress is a net $661 million increase over the amount proposed by the Administration. Use of the added funds for key programs—Army modernization, B-70, cargo planes for Military Air Transport Service, airborne alert, space satellites, Convair F-106, fleet ballistic missile program—still hinges on approval and release by the Bureau of the Budget and the Secretary of Defense.

Congress increased specific programs, mostly in procurement and research and development, by a total of over $1 billion. Then it applied an across-the-board 3% cut in all procurement categories, which reduced the increase by over $400 million. Sen. Dennis Chavez (D.-N. M.), chairman of the Senate Appropriations Military Subcommittee, explained that this action was taken "with the hope that it will give impetus to better contractual procedures."

The two main objections to the defense budget voted by Congress came from Sen. Stuart Symington (D.-Mo.), who told the Senate that it is "inadequate for the security of the U. S.," and Sen. Joseph Clark (D.-Pa.), who argued that the level of defense spending should be increased by $3 billion a year. Sen. Symington did not vote on passage of the measure; Sen. Clark voted against it. On final passage, the House vote was 402 to 5, the Senate vote, 82 to 4.

Congressional increases for hardware and research were partially offset by reductions aimed at forcing economies in administration and operations. The requests of the three services for increased military personnel budgets were cut, and Air Force and Navy requests for operations and maintenance funds were substantially reduced.

The net increase for procurement was $435 million; for research and development, it was $268 million.

The two most controversial programs, which ultimately survived strong Congressional opposition, were $293 million for a new conventionally-powered Forrestal-class carrier for Navy and the Air Force's Boeing Bomarc-B air defense program.

A House reduction of $294 million in the Bomarc program—$40.4 million asked for Fiscal 1961, plus $253.6 million in previous appropriations—was defeated. This would have ended the operational program. In final action, Congress restored $244 million of the House reduction. This left the Bomarc-B program with no new funds for Fiscal 1961, and minus $9.6 million from previous year funding.

Highlights of the Fiscal 1961 budget:

- **Boeing B-52H.** $371 million is allocated to complete the objective of 14 heavy bomber wings. Estimated cost is $7.9 million each.
- **Convair B-58.** $505 million is earmarked to complete this program, at a cost of $14.8 million each.
- **North American B-70.** In addition to the $75 million requested for two prototypes, Congress voted $190 million to develop the Mach 3 bomber as a full weapon system.
- **Convair F-106.** Congress voted $100 million for the interceptor, which was not requested by Air Force, with the provision that the money could be switched to the B-70 program.
- **Boeing KC-135.** $224 million will complete the force level planned for Fiscal 1963.
- **Republic F-105.** $535 million is provided to complete the force level objective for Fiscal 1963.
- **Lockheed C-130B.** In addition to the $70.4 million asked by the Administration for 25 C-130Bs for non-MATS

Air Force Research and Development Program

Below are details of the approved Air Force research and development funded by the Fiscal 1961 budget. In addition to the projects listed, Congress voted $190 million for the B-70 program, $33.8 million for the Samos reconnaissance satellite program, and $50 million which may be applied to Minuteman intercontinental ballistic missile, Discoverer research satellite, Midas missile warning satellite, or to Samos. Figures below are in millions.

Operational Development	
Strategic Systems	$1,222.2
Samos	199.9
Atlas	232.9
Titan	409.4
Minuteman	291.2
B-70	75.0
Hound Dog	10.6
Studies	2.2
Air Defense Systems	62.6
Midas	41.0
Bomarc	20.1
Studies	1.5
Tactical Systems	6.7
Bullpup	5.2
Studies	1.5
Control and Support Systems	63.5
Communications	14.0
Intelligence Data Handling Systems	9.7
SAC Control System	16.7
Electromagnetic Intelligence System	6.4
Weather Observation and Forecasting	2.0
Powered Targets	4.0
Space Track	4.7
Command Control System	3.0
Studies	3.0
Operational Support	40.7
Support Equipment	2.9
Guidance and Weapons	14.0
Electronics and Communications	13.6
Reconnaissance and Intelligence	6.6
Aerospace Environment	.2
Human Factors	1.7
Targets and Drones	1.7
Advanced Development	
Advanced Systems	303.5
X-15 Research Vehicle	6.0
Dispersed Site Tactical Fighter	31.0
Dyna-Soar	50.0
Anti-ICBM	5.0
Aircraft Nuclear Propulsion	75.0
Skybolt (GAM 87)	60.0
Discoverer	15.1
Hyperenvironment Test System	2.2
Avro Vertical Takeoff Aircraft	1.0
Hiller Tilt Wing Aircraft	.2
MATS Modernization	50.0
Test Instrumentation	14.0
Subsystems and Components (Pluto)	7.0
Development Support	99.4
Rand	13.5
Lincoln Laboratory	21.0
Mitre	20.0
Space Technology Laboratory	43.9
Anser	1.0
Research	
Applied	237.0
Basic	42.1
Propulsion	9.0
Materials	11.3
Electronics	7.7
Geophysics	3.8
Biosciences	2.7
Aeromechanics	7.6
Command Operations	
Civilian Personnel	150.7
Contractor Operated Installations	126.3
Supplies and Equipment	64.1
Other	49.6

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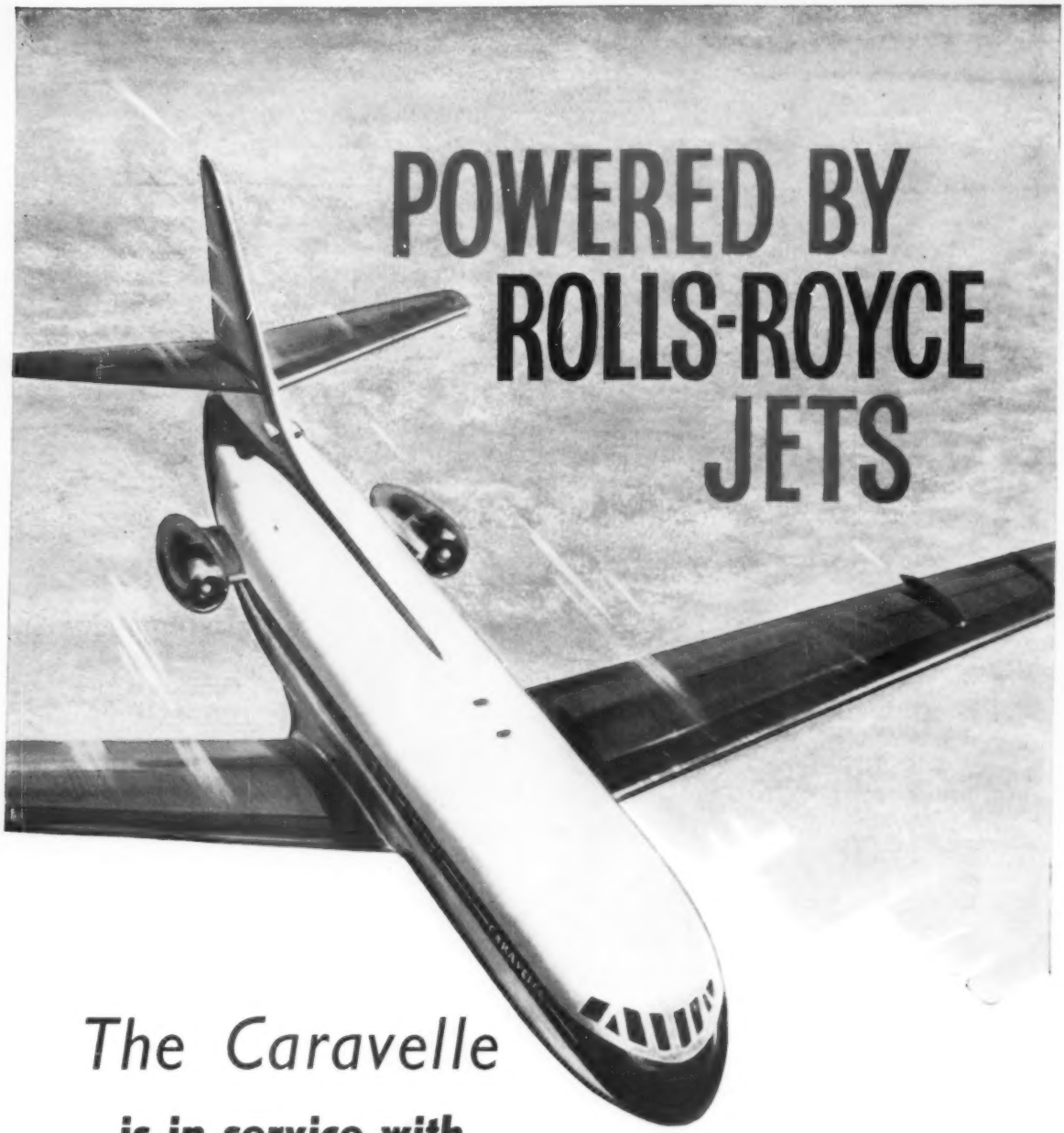

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Fiscal 1961 Defense Appropriations

(BILLIONS OF DOLLARS)

	FY 1960 Approp.	Admin. Request FY 1961	Approved by House	Approved by Senate	Approved by Congress
Army	$9.37	$9.31	$9.40	$9.65	$9.53
Navy	11.00	11.81	11.90	12.24	12.11
Air Force	17.49	17.00	16.84	17.43	17.15
Secretary of Defense	1.37	1.21	1.19	1.19	1.19
Total, Department of Defense	39.23	39.33	39.33	40.51	39.99

Included in the totals above are the following allocations for procurement and research and development.

Procurement Appropriations

(BILLIONS OF DOLLARS)

Army: Equipment and Missiles	$1.40	$1.34	$1.37	$1.59	$1.49
Navy: Aircraft and Missiles	1.96	2.11	2.14	2.21	2.14
USAF: Aircraft	4.28	2.99[1]	3.22	3.61[2]	3.25
USAF: Airlift Modernization	....	....	.359	....	.310
USAF: Missiles	2.54	3.02	2.38	2.82	2.61

[1] Includes $120.4 million included by the House and also in final congressional action under a separate "airlift modernization" appropriation.

[2] Includes $370.4 million for "airlift modernization."

Research, Development, Test, and Evaluation

(BILLIONS OF DOLLARS)

Army	$1.03	$1.04	$1.04	$1.04	$1.04
Navy	1.01	1.17	1.27	1.21	1.22
Air Force	1.16	1.33	1.54	1.55	1.55
Advanced Research Projects Agency	.455	.215	.215	.215	.215
Department of Defense: Emergency fund	.150[3]	.150[3]	.150[3]	.150[3]	.150[3]

[3] In addition, authority to transfer $150 million from other appropriations.

airlift, both House and Senate Appropriations Committees stated their intention that $140 million—of the total $200 million voted for interim MATS modernization—should be used to buy an additional 50 C-130Bs with extended range.

• **MATS aircraft.** The House and Senate Appropriations Committees gave varying instructions as to what type of plane should be purchased with the remaining $60 million for interim MATS modernization.

The Senate group said it should be "a long range turboprop or turbofan type aircraft with adequate volume and cross section for combat equipment, with provision for straight-in loading." The House committee specified that it should be "a side-loading type [which will require the least modification, and thus provide the most immediate delivery] as opposed to the development of a swing-tail version."

In addition to the $200 million for interim MATS aircraft, Congress approved, without controversy, $50 million for development of an advanced cargo transport to serve as the future backbone of MATS operations.

• **USAF trainers.** The budget includes $9.8 million for 50 Cessna T-37s; $168 million for 144 Northrop T-38s; and $64.5 million for 52 North American T-39s.

• **Airborne Alert.** The $170 million voted to develop an on-the-shelf capability is twice the $85 million proposed. In addition, Congress gave the President authority to use any funds that might be required for an air alert.

• **Convair Atlas.** $1.2 billion in the Fiscal 1961 budget provides for full financing, through Fiscal 1963, of the 13 planned squadrons of the intercontinental ballistic missile. The first seven squadrons will have 10 missiles, and the last six will have 13 each.

• **Martin Titan.** The budget provides $1 billion to complete financing of the programed 14 squadrons.

• **Minuteman.** The budget includes $395 million for development and production of the solid propellant intercontinental ballistic missile.

• **North American Hound Dog.** $170 million is provided for this air-to-ground missile.

• **McDonnell Quail.** $71.2 million is scheduled for this air launched decoy missile.

• **Air-to-air missiles.** Air Force funds are earmarked for these missiles: Hughes GAR-3A, $9.3 million; Hughes GAR-4A, $25.6 million; Philco GAR-8 Sidewinder, $10 million; Hughes GAR-11, $41.5 million.

• **Lockheed Polaris.** The $1.3 billion appropriated by Congress for the fleet ballistic missile program includes $230 million for missiles. This budget would fully finance five nuclear-powered submarines and partially finance seven. The $1.1 billion program recommended by the Administration, including $207 million for missiles, would fully fund three ships and partially fund nine.

• **Nike Zeus.** Congress voted $287 million, the full amount requested, for research and development on the anti-missile missile.

Space Budget Passed, FAA, CAB Funds Cut

Washington—Congress approved the full Fiscal 1961 budget request for the National Aeronautics and Space Administration before recessing until August, but it cut budget requests for military construction, the Civil Aeronautics Board and Federal Aviation Agency.

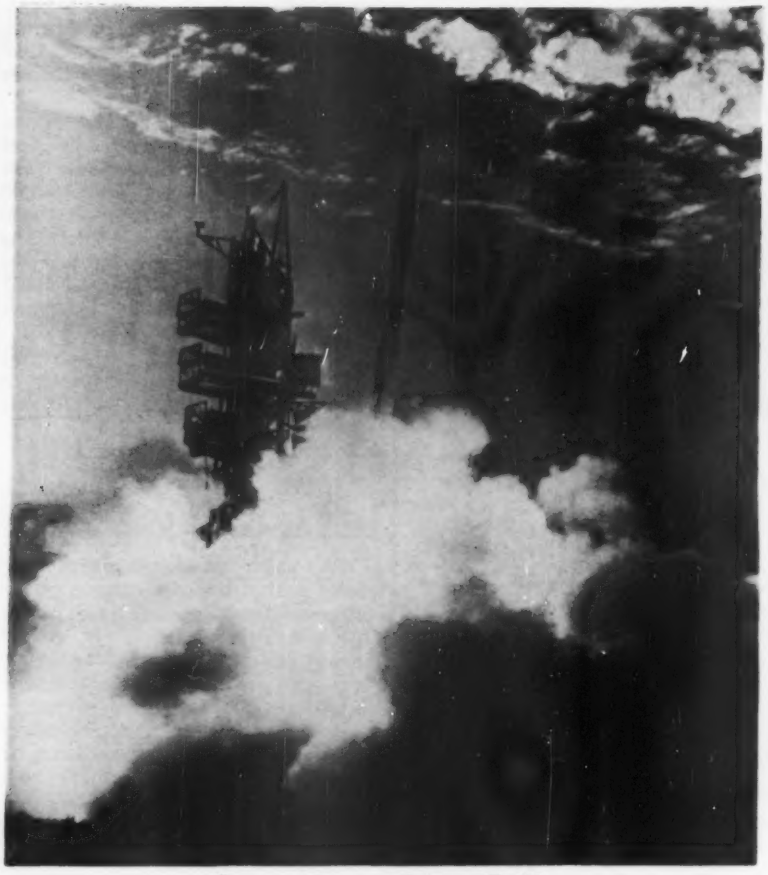
Congress passed these appropriations:

• **National Aeronautics** and Space Administration—$915 million for Fiscal 1961. The House voted only $876 million, but the Senate increased this to $965 million. Of the $915 million approved in House-Senate conference, $170,760,000 is for salaries and expenses, $621,453,000 for research and development and $122,787,000 for construction and equipment.

• **Civil Aeronautics Board**—$72,392,500 for Fiscal 1961, over $4 million less than requested. Of this amount, $65 million is for air carrier subsidy and $7,392,500 is for salaries and expenses.

• **Federal Aviation Agency**—$690,494,000 for Fiscal 1961, a reduction of $22.5 million from budget requests. This includes $373,064,000 for expenses; $163,250,000 for establishment of air navigation facilities; $80 million for grant-in-aid for airports; $64 million for research and development; $3,230,000 for operation and maintenance, $4.5 million for construction at Washington National Airport and $2,450,000 for operation and maintenance at Dulles International Airport.

• **Military construction**—$994,855,000 for Fiscal 1961, a cut of $123 million from budget requests. As approved, military construction for the Air Force amounts to $609,501,000; Air Force Reserve, $4 million, and Air National Guard, $13.850 million. Army military construction budget is $148,407,000; Army Reserve, $16,038,000, and National Guard $17,540,000. Navy military construction is set at $162,519,000, plus $4 million for the Naval Reserve.



Scout Launching Fails

First attempt by National Aeronautics and Space Administration to launch a complete four-stage Scout solid propellant sounding rocket and satellite booster failed July 1. First three stages ignited as programed. Ignition of fourth stage was prevented by command from the Wallops Island, Va., launch site because the vehicle appeared to veer off course, NASA said. Scout had reached an altitude of some 860 mi. and range of about 1,500 mi. Excellent telemetry was obtained on first three stages, NASA said. This was the first flight of three controlled solid propellant stages. Mission of the 193-lb. payload was to measure propulsion performance, structural integrity and effect of environmental conditions on the vehicle and its guidance and control system.

Nuclear Engine Plans Expected to Continue

Washington – Rep. Melvin Price (D.-Ill.), chairman of the Joint Congressional Atomic Energy Subcommittee on Research and Development, anticipated last week that Department of Defense will continue indefinitely with two approaches to aircraft nuclear propulsion—the direct cycle under development by General Electric Co. and the indirect cycle under development by Pratt & Whitney Aircraft Division of United Aircraft Corp.

Secretary of Defense Thomas S. Gates is scheduled to submit a report evaluating the programs to a special House appropriations subcommittee, headed by Rep. George Mahon (D.-Tex.), before Oct. 1 (AW June 6, p. 25).

Price discredited "a general misunderstanding" that the Gates report will make a choice between the two approaches. Such a determination "could not possibly be made by September unless a real obstacle that could not be overcome should develop in one of the programs," Price declared.

News Digest

Aerospace Corp., new nonprofit organization which will manage Air Force missile and space programs, last week named I. A. Getting as its president. Martin Schilling will succeed Getting who resigns as vice president-engineering and research for Raytheon Co.

Option agreement for 20 Vertol 107 Model II twin turbine helicopters has been completed between Royal Swedish Naval Administration and Vertol Division of Boeing Airplane Co.

Gerald A. Wynn-Wynne, public relations officer for British Overseas Airways Corp. in the Americas for the past 15 years, died June 28 at Essex, Conn., after suffering a heart attack.

$7 million letter contract for development of the new HU-1D version of the Bell Iroquois T53-powered Army helicopter (see p. 115), calling for production of an undisclosed number of aircraft, has been awarded Bell Helicopter Corp.

Harvey Gaylord, former president of Bell Aircraft Corp., was elected president and treasurer of Bell Aerospace Corp., now a wholly owned subsidiary of Textron, Inc. Leston Faneuf, former president and later chairman, was named a director, and John E. Bierwirth, chairman of National Distillers and Chemical Corp., was named Bell Aerospace chairman.

First working optical Maser which is expected to play a vital role in future space communications and radar systems (AW Dec. 14, p. 87), was claimed here last week by representatives of Hughes Aircraft Co. The company says the device provides a coherent source of radiation in the visible portion of the spectrum, at roughly 400 megamegacycles (in the midst of the red portion of the spectrum), many times the highest frequency obtained by conventional electronic techniques.

Soviet Rocket Tests

Washington—Soviet Union completed its latest series of rocket tests into the Pacific last week with two successful launchings over a range of some 8,078 mi. Russians said each of the two dummy last stages re-entered the atmosphere and hit the water near the planned point in the 17,136 sq. mi. target area. Soviet news agency Tass said the successful tests of "the new version of a powerful multistage carrier rocket" yielded all the data necessary to complete tests development of the vehicle.

Russia also announced that a one-stage geophysical rocket carried a 2,242 lb. payload to an altitude of 129 mi. Payload included a rabbit and two dogs, one of which was making his fifth rocket trip, Prof. A. A. Blagonravov said. Instruments photographed cloud cover and measured infrared radiation of earth and atmosphere, ionized clouds, ion composition of the atmosphere, ultraviolet radiation of the sun, current field intensity on the rocket's surface and meteorological parameters. Animals and instruments were recovered, and new information on muscular tone of animals under zero gravity was obtained, Blagonravov said.

CAB to Cancel Military Contract Bidding

Defense warned it will have to pay standard rates; supplemental carriers oppose Board policy reversal.

By L. L. Doty

Washington—Civil Aeronautics Board told the Defense Department last week that it is ready to eliminate the practice of competitive bidding by commercial airlines for military airlift contracts.

Although the CAB has frequently raised objections to competitive bidding and, as late as last April, promised to review the procedures, the move came as a surprise since it is the first time that actual steps toward dropping the policy have been taken. Competitive bidding was adopted as an emergency measure during the Korean War to increase airlift capacity across the Pacific and has been in effect on all routes since then.

The scheduled airline industry promptly endorsed the Board action, but supplemental carriers are expected to put up strong opposition against it. Capitol Airways protested that the Board move will deny the right of supplemental carriers to engage in defense and military charter work and will "secure for the regular route carriers a priority or right of first refusal for all military traffic."

Defense Department is also understood to have shown resistance to the Board action. At the present time, Military Air Transport Service uses competitive bidding for over 98% of its commercial air transport procurement. Scheduled airlines have long fought for a system of established rates and tariffs in contracting for military traffic.

As of late last week, the Board decision had not been issued in the form of an order but was announced in a letter of intent to Defense Secretary Thomas S. Gates, Jr., from CAB Chairman Whitney Gillilland. In the letter, Gillilland gave this reason for taking the action:

"The position, that the use by MATS of advertised competitive bidding for the bulk of commercial augmentation of airlift is not conducive to sound economic growth and development of air transportation capability, is consistent with the Board's publicly-expressed views, with the Department of Commerce Report on Federal Transportation Policy submitted to the President in March and with the recent recommendations of the Reed Committee to the Secretary of the Air Force."

Technically, Gillilland's action is a reversion to the Federal Aviation Act of 1958, since the practice of competitive bidding was made possible only through exemptions granted by the CAB from various requirements of the Act and of the Board's Economic Regulations. The grant of exemptions meant that the airlift conducted by commercial airlines was exempt from provisions of the Act which, nevertheless, applied to civilians and other government users of commercial air transportation.

In his letter, Gillilland emphasized that the exemptions were granted because carriers certificated to operate on the Pacific routes during the Korean War did not have the capacity to fulfill national defense demands and that other civil carriers were, consequently, essential to the over-all Korean airlift. He noted that capacity since that time has increased substantially and ". . . can scarcely any longer be considered inadequate to meet usual Department requirements . . ."

"There is no longer any apparent reason why such traffic should not move at published tariff rates in the services such carriers can perform under their certificate authorizations," he said.

If an order cancelling the exemptions is issued, carriers would be subject to the tariff and rate provisions of the Federal Aviation Act and would be required to publish rates to be charged the Defense Department. Although such rates, which can be changed only on 30 day notice, would not necessarily conform to those published for regular traffic, competitive price-cutting would be prevented by the requirement that rates be non-discriminatory, fair and reasonable.

Scheduled airline industry has long held the view that the common carrier national transport system is based upon filed and published tariffs and that the principal public advantage of such a system is that it prevents discriminatory practices. In the past, the industry has charged that MATS competitive bidding practices place an undue burden on present users of air transportation.

The Air Transport Assn. has held that the general grant of exemptions "permitted the military to use a competitive bidding process which encouraged rates less than publicly-filed rates and, in many cases, less than the economics of the operation could sustain."

In his letter, Gillilland hinted that the supplemental carriers would be protected in the allocation of military traffic when he noted that "the Board recognizes that there will continue to be a substantial requirement by the Department for additional commercial air transport services. Absence of availability would tend to support issuance of exemptions in such cases."

However, Gillilland gave his full approval and support to a recent Defense Department program, which has been approved by President Eisenhower (AW Feb. 15, p. 36), calling for contracts only with those carriers committed to the Civil Reserve Air Fleet whose facilities are most suited to defense needs and which show a willingness to acquire "uncompromised cargo aircraft."

Southern Pilot Strike

Washington—Air Line Pilots Assn. moved to invoke a six-year-old policy decision against strike-breaking last week in an effort to dislodge non-union pilots employed by Southern Airways as a result of ALPA's month-old strike.

Members of the union's master executive board voted to apply the ruling, which would have the effect of Southern pilot picket lines being observed by all ALPA pilots, cutting off all airline service to cities served by Southern. Local council chapters were scheduled to take a final vote on the matter late last week.

Southern is now training 46 new non-union pilots, is operating 20% of its regular schedules and is serving 34% of its route system. Southern spokesman said a company offer, which would give senior pilots an $18,000 annual salary range, was rejected by the pilots in February, and an offer of arbitration was turned down by the company.

Should ALPA succeed in getting all members to respect the Southern picket lines, airline operations to points served by Southern could be interrupted enough to warrant government intervention and the appointment of a presidential fact-finding board.

FAUCETT DC-4 completes landing roll at Cusco. Landings are normally made in this direction to take advantage of the moderate uphill grade. Indians often gather around the runways to watch the aircraft, but in this case an arriving athlete brought out a crowd.

Faucett Seeks Route Between Peru-U.S.

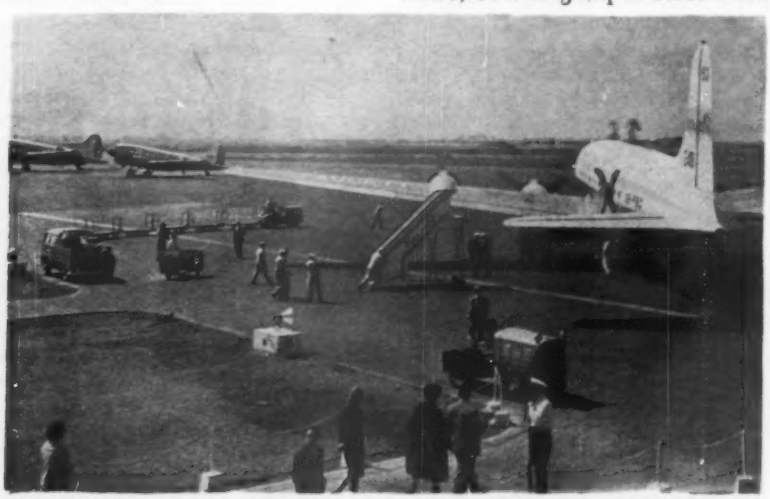
By William H. Gregory

Lima, Peru—Faucett Airlines is departing from its 31 years of mountain and jungle flying exclusively within Peru with an application for a route to the United States.

The airline, founded by an American and still owned privately—20% of it by Panagra—is about to take delivery of its first Douglas DC-6 which will be brought to zero engine and airframe time by Pan American World Airways in Miami. Peru's bilateral treaty with the United States provides for the Miami service Faucett wants, and if the Civil Aeronautics Board approves Faucett's application the route would be served with DC-6s.

For the immediate future, Faucett will place the first piece of pressurized equipment it will own on its principal passenger route within Peru—from Lima to Cusco, the heart of the Inca Indian empire, a tourist attraction now and potentially a major one.

Though not unique in Peru, the Cusco route is an unusual one by conventional airline standards. Flown now by unpressurized Douglas DC-4s or occasionally by a DC-3A Panagra-developed conversion with Pratt & Whitney R2000 engines replacing Pratt & Whitney 1830s, the route requires crossing a section of Cordillera Blanca or snow capped range of the Andes at 20,000 ft. and landing at the semi-hardened 5,250-ft.-long strip at Cusco which has an elevation of 10,840 ft. A twice-weekly DC-3 cargo-passenger flight to Quince Mil and Iberia also stopped at Cusco.



FAUCETT DC-4 arrives at Limatambo Airport at Lima, Peru. C-46 and DC-3 in background belong to TAM, Peruvian military airline.

The strip has a small uphill grade, and takeoffs and landings are made only in one direction to take advantage of the grade. The DC-4 flight normally offloads fuel to get off again for Lima.

Faucett flies its scheduled trips to Cusco in the morning. This offers the best combination of finding light winds at Cusco for the one-way landing and for avoiding either the severe thunderstorms likely over the mountains during the Peruvian summer from November to May or of finding Lima open during the South American winter when low ceilings can be expected on the coastal plain in the afternoon. Special trips are flown in the afternoon if the weather is satisfactory.

The Cusco DC-4 flight departs from Lima with a maximum permissible gross weight of 63,000 lb. and with a fuel load of from 1,400 gal. minimum for this flight to maximum fuel load of 1,800 gal. To gain altitude, the flight parallels the Peruvian coastline until it reaches Pisco, about 100 mi. to the south.

By this time the flight has gained 9,000 ft. at which point the airplane's oxygen system automatically switches on and the engines are placed in high blower. The DC-4s carry two oxygen bottles brought to 400 psi.—enough oxygen for 55 passengers and crew for 2½ hr.

Pilots use masks, but the passengers take their supply from rubber tubes

FUEL is offloaded in drums if necessary to bring the DC-4 down to the maximum gross weight for takeoff from the 10,800 ft. elevation field at Cusco. The strip is a mile long. No servicing other than passenger handling necessities is done here.

with pipestem style mouthpieces which are provided at each seat.

There are two uniformed stewardesses and a steward on the DC-4, the latter using a portable oxygen bottle and mask.

Though this AVIATION WEEK editor found them a good deal more awkward to use than a mask during a recent flight to Cusco and return, they are much more practical for passenger use since they are quickly removable and can be renewed with a sterile-packaged mouthpiece for each flight. The flow is constant and the passenger works out for himself a system of inhaling and exhaling.

The flight turns east for Cusco and continues its climb until it reaches the normal cruising altitude of 20,500 ft. Oxygen flow is automatically increased as altitude is gained.

Cruising Altitude

Cruising altitude will carry the flight on top of the first high range of the Andes with peaks of 16,000 to 17,000 ft. Approaching Cusco, however, the flight follows a relatively narrow valley running roughly southeast with three 20,000-ft. peaks following in succession in the range to the north. This passenger actually found himself looking up at the top of the last one—Cerro Salcantay, whose 20,574 ft. crest topped the airplane's altitude.

Because of the altitude, stalling speed of the DC-4 is higher at Cusco. At 55,000 lb. landing weight with 45 deg. flap, for example, the sea level stalling speed of 78 mph. increases to 90 mph.

In unfavorable weather the DC-4s will operate as high as 25,000 ft. going into Cusco.

The DC-3A, if flown there, can reach 24,000 ft. cruising altitude.

No night flights are operated into or

ROUTE MAP shows Faucett's mountain and jungle terrain. DC-4s operate to Cusco, Arequipa, Talara and Iquitos. Chiclayo in the north is a cargo operating base and the routes inland from Chiclayo and Trujillo are major cargo runs. Main ridge of the Andes running north-south through Peru is outlined. Jungle lies to the east.

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PASSENGERS are shown using pipestem oxygen system on Cusco flight.

out of Cusco so the field has no lights. There is a non-directional homer at Cusco and at Urco southeast of Cusco. The only bad weather procedure permitted is to pass the Cusco station to make sure the high mountains to the west are cleared, make a 180 deg. turn at Urco and let down. If the airplane hasn't broken out at 16,000 ft., the company procedure calls for immediate climb to cruising altitude and return either to Lima or to the normal alternate, which is Pisco.

Maximum takeoff weight for the DC-4 at Cusco is 54,300 lb. If the airplane has too much fuel, it is offloaded into drums and taken by surface transport on eastward to a jungle strip called Quince Mil where Faucett serves a rubber-growing operation with cargo DC-3s.

No fueling or other servicing other than baggage handling is done at Cusco. The flight is scheduled to leave Lima at 6 a.m. daily and requires 1 hr. 45 min. at 240 mph. TAS. As fast as the airplane can be unloaded and cleaned for the return flight, it is turned around and takes off for Lima again, with arrivals scheduled at 11:30 a.m.

Takeoff is west, downgrade and jet style; engines are run up with brakes on until full power is reached and brakes are released.

Cusco is one of four routes served by Faucett's four DC-4s. Two others, one to Talara north of Lima and the other to Arequipa to the south are flown over the low, narrow coastal plain of Peru. The fourth goes to Iquitos in the jungle at the headwaters of the Amazon river and also involves crossing the high Andes.

Prevailing weather and airport conditions tend to outweigh utilization in scheduling. One airplane is assigned to each of the four routes, and there is no effort to take an airplane arriving from Cusco, for example, and turning it around at Lima to fly the Arequipa segment.

Extra sections, not unusual at Cusco during the tourist season, are gained by canceling the Talara flight, which can then be rescheduled for late in the day. Only Talara has night landing aids at the airport.

Training flights and maintenance are scheduled during the nonscheduled hours. Faucett's aircraft show a high standard of cleanliness and the airline's operations director, Gen. F. A. P. Armando Revoredo, said great emphasis is placed on careful maintenance because of the large amount of mountain flying performed.

Faucett has a Federal Aviation Agency approved overhaul shop at its central base at Limatambo Airport at Lima and maintains transient U.S. military aircraft as well as its own.

Gen. Revoredo said Faucett is primarily interested in turboprop transports in its long-range equipment plans and is considering establishing turbine overhaul and maintenance facilities. Both the Vickers Vanguard and the Lockheed Electra are being studied seriously, he said.

An aircraft like the Electra has natural advantages on Faucett's short-range routes utilizing small fields, but with sufficient flexibility to be used on the proposed Lima-Panama-Miami route.

Economic considerations are pushing Faucett in its expansion moves. For a passenger flying from the United States to Cusco, Gen. Revoredo pointed out, Faucett reaps only 10% of the revenue —from Lima to Cusco—and this is paid in Peruvian soles that have suffered from inflation. But, he added, Faucett must purchase its aircraft in harder-to-obtain and expensive dollars.

Also a contributing factor is the recent appearance of the Peruvian airline APSA, which has been flying DC-6s between Lima and Miami with satisfactory passenger loads. Faucett has no competition within Peru, except for the Peruvian military airline TAM in the sense that MATS may be regarded as competition by U.S. airlines.

Faucett has 11 DC-3s, primarily used in cargo operations in the north. It has one DC-3A and will buy another from Panagra, from which it also bought its first DC-6. It has 48 pilots and copilots and a total of 650 employes.

Four Faucett-built single-engine eight-passenger F-19s powered by Pratt & Whitney Wasp engines still are operated by the airline for special charter work. These aircraft are based on the Stinson SM-1F Detroiter that made up the original Faucett fleet.

Faucett publishes no annual report, but the number of passengers carried has been running in the neighborhood of 150,000 a year and cargo carried on the order of 15,000 tons.

Its cargo operations have been handicapped by a one-way problem, but are important in a country like Peru with difficult terrain for surface transport. Its newest cargo effort is the supply of a Cerro de Pasco oil exploration operation in the jungle at Izcosazin in which it flies in the drilling equipment to a strip hewed out of the forest for the project.

The airline founder, Elmer Faucett, was an American who came to Peru as a mechanic and who took out his back pay in flying lessons when his employer went bankrupt there. Later he found backers who provided $40,000 to buy two Stinson Detroiters and his airline was launched. He died last April.

Allegheny Proposal Rejected by Board

Washington—Civil Aeronautics Board has denied an Allegheny Airlines request for the consolidation of its application for nonstop rights between New York and Washington in the New York Short-Haul Investigation.

Allegheny has proposed the lifting of the restriction requiring one-stop service between New York and Washington and the introduction of its non-reservation economy service on the route. It moved to consolidate this application in the New York Coach Case on grounds that existing trunkline carriers oppose the non-reservation economy service and operate coach service predominantly as a part of their long-haul services.

The Board denied the motion because "Allegheny has failed to allege facts sufficient to warrant the late filing of the request for consolidation. . . ." Allegheny said it filed late because operational results from its non-reservation Pittsburgh economy service have only recently become available.

The Convair F-106 sets record as world's fastest jet aircraft...

powered by a Pratt & Whitney Aircraft J-75 jet engine

At Edwards Air Force Base on December 1, 1959, the F-106 all-weather interceptor roared to a new world speed record of 1,525.95 miles per hour. Flying a straightaway course at an altitude of 40,000 feet, it bettered the previous official world mark by 122 miles per hour.

On March 1 this year, the Air Force F-106 also demonstrated that it has low-level striking power. At elevations of 50 to 300 feet, under most adverse conditions, the F-106 averaged 700 miles an hour in a 300-mile flight from Edwards Air Force Base.

Pratt & Whitney Aircraft's J-75 jet engine powers the F-106. With this same engine, Republic's F-105D fighter-bomber recently set a new speed record for closed-course flight. Over the years, Pratt & Whitney Aircraft J-57 and J-75 jet engines have held virtually every major flight record.

PRATT & WHITNEY AIRCRAFT

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First Boeing 707-120B Turbofan Transport Flies

First Boeing turbofan-powered jet transport—a 707-120B for American Airlines—makes its maiden flight from Boeing's Transport Division at Renton, Wash., powered by four Pratt & Whitney JT3D-1 turbofans of 17,000 lb. takeoff thrust each. The 120B includes modification of the wing leading edge between the fuselage and inboard engines for more sweepback and addition of three segments of leading edge flap (AW Aug. 24, 1959, p. 36). After Federal Aviation Agency certification, American plans to modify 24 120s to the B-model configuration; company says maximum cruising speed will be 610 mph. Qantas Empire Airways of Australia has ordered three of the turbofan-powered transports and later will modify its present fleet of seven 120s to the newer model. The JT3D-1 engines also will be installed on Boeing 720B intermediate range transports (AW June 27, p. 45).

Settlement of Six Year Rate War In Latin America Appears Unlikely

Washington—Prospects for a settlement of the stormy six-year-old rate-cutting war involving more than 60 carriers operating in Latin America now appear dim despite promising signs last year that some compromise could be reached.

The bitter conflict, stemming from rapidly mounting competition throughout the continent, has blocked airline members of International Air Transport Assn. from closing rates in this area. Although an open-rate situation does exist, there is no indication that IATA members are ready to slice their fares to meet the lower rates offered by a number of Latin American carriers—in some cases as low as 40% under standard rates.

Here is the background to the current price battle:

• **Last year,** IATA member airlines were granted an exemption which would permit them to cut fares by as much as 10% below the lowest rates offered by competitors. The exemption was never applied by any of the IATA airlines, and a resolution cancelling the exemption was passed by the Honolulu traffic conference (AW Oct. 19, p. 38).

• **Meeting of governments** in Rio de Janeiro early last year (AW Jan. 19, 1959, p. 39) resulted in an agreement in principle that IATA rates would be accepted as standard rates on all South American routes. It was further agreed that fares in effect at that time would be frozen to stave off any further rate-cutting until the airlines of the governments involved could meet to resolve the technicalities of a tariff structure.

• **Meeting of the airlines** in Lima (AW Mar. 23, 1959, p. 48) gave some promise that at least the majority of the Latin American carriers would conform to a standard rate structure subject to supervision of the governments involved. IATA members made one concession: an exemption was granted that would permit underdeveloped airlines to sell tickets at a fare 10% below regular rates for a period of one year.

• **IATA traffic conference** in Honolulu agreed on a rate standard for South America to be effective Apr. 1, 1960. However, the rates were never actually closed since few carriers were willing to bind themselves to standards which might not be generally recognized in South America.

As matters now stand, rate-cutting is as rampant as it was before the government and carrier conferences gave some hope that an equitable rate structure was in the making. So-called underdeveloped airlines, which last year were operating second-hand equipment on irregular schedules, have now modernized their fleets and improved their services. Nevertheless, they continue to take advantage of the 10% exemption granted underdeveloped airlines despite the fact that the one-year period provided for the exemption has long expired. One airline spokesman observed to AVIATION WEEK: "How is it possible for an airline operating a fleet of Bristol Britannia turboprops to consider itself underdeveloped?"

One airline, a Peruvian carrier, is offering a 10% discount to all citizens and residents of Peru. In Chile, carriers are selling tickets at rates of exchange well below the standard rate of exchange which U. S. carriers must charge.

Some airlines operate equipment equivalent to the first-class equipment provided by the larger carriers but confine their operations to profitable routes, thus permitting a 20% reduction on airline tickets. In some areas, a 40% discount has been the practice for a number of years and still remains in effect.

Although IATA carriers are not ready to fight back by cutting prices, they are continuing to force through some rate stability through consultation with the governments and the carriers involved in the rate-slicing.

PROBLEMS? OR PROFITS?

Route pattern complexities of typical airlines demand a cargo aircraft with the capability of operating over both short and long route segments with excellent economy and earning ability. The Canadair Forty Four will do this for you! It combines the air cargo feeder liner with the long range aircraft to provide a standardized economic fleet unit. The Forty Four will give you profit-making operations, at current rates, over route segments as short as 200 miles and as long as 4,000 miles.

This is the type of flexibility that will answer the many and varied problems confronting airline operators who, because of the growing demands of shippers, are being forced to provide a combination of short, medium and long range air cargo services for the carriage of freight at attractive and competitive tariffs. In this situation, the Canadair Forty Four offers excellent economy and earning ability over the complete range of route structures that must be provided in the collection and distribution of air cargo.

Practical applications of this are found in the short route cargo services that are necessary in the supply and distribution of goods to or from the terminal points of transcontinental and trans-Atlantic services. This is evident between the major cities of the Eastern United States and between the principal points of Europe. These inter-city runs are essential extensions to the long haul trunk service, and with the Forty Four can be handled without a change of aircraft.

The need for this system of short, medium or long range operations will develop through the growing awareness among business establishments that the carriage of articles by air is becoming an essential element in the overall marketing function. This will open up new markets, new transportation requirements, new inter-city services. The Forty Four, with its flexibility of performance, can carry cargo at a profit over the whole distance spectrum—short, medium and long range, and has the airfield performance characteristics to get in and out of 85% of the world's major airports. THESE ARE DECISIVE ADVANTAGES IN FAVOR OF THE FORTY FOUR.

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1. From runways as short as 6,000 feet, can operate with 70% payload up to stage distances of 3,000 miles.
2. Can operate from 85% of the world's major airports, with due consideration to both runway length and allowable wheel loading.
3. Will earn an operating profit with load factors as low as 30%.
4. Breakeven load factors in the Forty Four represent loss loads on larger proposed equipment.
5. Breakeven load factors on larger proposed equipment represent major profit payloads on the Forty Four.
6. Can operate *non-stop* on the London-New York route with an average annual payload of over 55,000 lbs.

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TWA Speeds Substitute Training To Relieve Stewardess Walkout

New York—Trans World Airlines late last week accelerated its in-flight training course for ground employes in an effort to halt a walkout that by Wednesday had attracted 125 of the carrier's 280 New York-based stewardesses.

The stewardesses, most of them assigned to TWA's international division, were staying at home to protest signing of an arbitration board contract (AW July 4, p. 43) which, they said, was inferior to earlier offers made by the company.

As the walkout gained support from rank and file hostesses, TWA resorted to supervisory personnel and hastily trained clerical workers in order to maintain international schedules. By noon last Wednesday, the company could call upon 218 substitute cabin attendants based at four TWA domiciles. Of these, 53 lived in New York.

However, TWA forecast that by Friday 290 substitutes would be available, 125 of them New York-based. This would exceed the normal stewardess complement on the carrier's international division.

The compressed TWA training course for substitute hostesses lasts approximately one day. Under Federal Aviation Agency regulations, the carrier is allowed to mix substitutes with fully trained hostesses and pursers on any flight involving more than one cabin attendant.

Demonstrating concern that the walkout might spread to domestic domiciles, TWA last week obtained summonses individually directed at about half the hostesses reporting sick. The company's aim was an injunction from the United States District Court here.

After about 10 members of the local Air Line Stewards and Stewardesses Assn. appeared before the bar with doctors' certificates attesting their illness, the judge—Edward Weinfeld—postponed the hearing until July 12. But first he issued a temporary restraining order against ALSSA and obtained the union's promise to urge its members to abide by the arbitrated contract.

John Clifford, director of industrial relations for TWA, in court took issue with ALSSA's contention that the arbitration award was a step backward in the 8-month long contract dispute. He said that the final award was a package, as were the company offers that preceded it, and that he could not contrast the two in dollar cost to TWA.

As of midweek, the walkout had not forced cancellation of a single TWA flight. But the corapany did admit that several extra sections were not booked to handle heavy Independence Day traffic, even though they were demanded by passengers.

A feeling of bitterness within TWA hostess ranks apparently was widespread last November when ALSSA agreed to submit all contractual issues to arbitration. Many hostesses and some pursers contended that the union bucked a majority of its membership in not holding out for higher rates of pay for jet transport cabin attendants. This group maintained that arbitration boards historically had returned findings that were sympathetic to the management point of view and could not comprehend hostess problems.

According to ALSSA, TWA had offered to lower maximum jet flight hours per quarter for international hostesses and pursers to 225. At the same time, the union said, TWA was willing to grant a 10% pay hike.

The arbitration board, however, recommended a contract calling for an 8% wage increase retroactive to May 1, 1959, and effective through Feb. 1, 1961, at which time salaries would be increased an additional 5%. It also set a ceiling of 78.5 hr. per month for domestic jet flight attendants and 235.5 hr. per quarter for their counterparts flying internationally.

ALPA Opposes FAA On Medical Question

Washington—Detailed extent of the Federal Aviation Agency's revised airman medical application is drawing heavy fire from pilots who view the broad scope of questions as a needless invasion of privacy.

FAA medical officers scheduled a meeting with the Air Line Pilots Assn. late last week to discuss pilot objections to the wording of the form, which requires pilots to agree to a release of personal medical histories from their personal physicians to the agency.

Defending the new form, which was revised a month ago, FAA contends that the 23-question medical history, plus the waiver provisions permitting the agency to query private physicians on the applicant's health, are a commonplace adoption of the same information contained in many insurance policy applications.

Reason for the change, FAA said, stems from the agency's need for greater background information on the incidence of heart condition, diabetes and mental disorders, which have been the subject of special pilot certification regulations since last October. In addition, the agency feels the quality of pilot medical examinations given by private doctors varies to a great extent, thus requiring a recheck of the applicant's medical history by FAA physicians.

As a practical example of the need for this detailed information, FAA cited accident investigation evidence that the pilot of a Piedmont Airlines DC-3, which crashed near Charlottesville, Va., last October with a loss of 26 lives, had been receiving treatments from two psychiatrists prior to the accident. Had the new medical form been in use, agency spokesmen point out, the pilot would have been required to report this treatment and, on the basis of further medical examination, might have been grounded.

Also being questioned by pilots is an FAA request for a record of auto traffic convictions.

FAA emphasizes that it has no interest in the occasional traffic conviction but is attempting to discover pilots who may have a lengthy pattern of such violations. Such an individual, FAA said, is likely to be irresponsible and therefore an unsafe flier who should not be awarded a license.

Typical of this problem is the recent case of a Midwest dentist who had a record of eight light aircraft crashes in five years, FAA said. Although it was suspected he had been flying while under the influence of alcohol, the subject was completely sober during the accident investigations which followed. A check with the local police department later revealed that in the same five year period he received 15 convictions for drunken driving.

2 Carriers to Support BMD With Airlift

Scott AFB, Ill.—Military Air Transport Service has awarded two contracts totaling $1,916,808.62 to two small California airlines to provide airlift support for the Ballistic Missile Division of Air Force's Air Research and Development Command.

The contracts, effective through Fiscal 1961, were with ASA International Airlines, Inc., for $1,601,478, and to Northern Express Airways, Inc., for $315,330.62.

Using a Douglas C-54G and a Douglas C-118A furnished by the government and "specially modified to carry missile components and engineering personnel," ASA will fly five round trips weekly between California and Florida. In addition, ASA will use a Douglas DC-6A/B to make two round trips per week between Los Angeles International Airport and Offutt AFB, Neb., with intermediate stops.

Airline Income & Expenses—April, 1960

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	30,337,545	659,788	454,999	1,866,327	.....	33,742,843	32,484,936	1,257,907
Braniff	5,676,419	164,468	81,403	172,566	25,733	6,221,060	6,195,735	−96,866
Capital	9,019,948	214,026	145,363	137,981	17,117	9,677,499	9,377,189	300,310[3]
Continental	4,380,000	69,000	45,000	82,000	18,000	4,709,000	4,353,000	101,000
Delta	10,137,000	176,000	144,000	344,000	.....	11,033,000	9,579,000	1,333,000
Eastern	23,123,989	432,293	1,034,534[2]	.....	21,356	24,766,458	23,064,673	1,402,209
National	5,967,863	108,948	26,388	175,431	60,653	6,552,496	6,648,576	403,810
Northeast	3,212,646	48,160	14,968	71,604	.....	3,418,325	3,498,587	−80,262[3]
Northwest	6,241,833	216,465	545,622[2]	.....	1,115	7,097,923	7,115,024	−180,958
Trans World	20,463,492	535,117	1,180,263[2]	.....	156,778	22,506,011	23,144,759	−586,515
United	23,701,689	943,673	2,040,673[2]	.....	124,679	27,035,597	26,947,192	310,477
Western	4,535,839	119,763	192,512[2]	.....	31,130	4,899,987	4,672,004	182,901
INTERNATIONAL								
American	533,360	8,408	197	43,604	.....	612,783	578,568	34,215
Braniff	642,196	15,035	.....	40,633	50,908	790,508	885,641	−111,648
Caribbean Atlantic	288,399	2,743	14,136[2]	.....	.....	309,901	265,808	41,794
Delta	271,000	4,000	.....	9,000	.....	297,000	350,000	−59,000
Eastern	2,153,991	47,127	90,394[2]	.....	66,420	2,361,347	2,233,415	96,722
Mackey	174,213	.....	792	4,009	2,300	194,840	184,286	10,554[3]
National	75,747	772	690	3,599	6,300	91,530	159,112	−67,582
Northwest	1,900,660	616,344	468,683[2]	.....	48,363	3,122,456	3,028,033	27,619
Pan American Combined	25,857,000	1,809,000	.....	3,134,000	566,000	32,729,000	29,932,000	2,256,000
Alaska	329,000	16,000	.....	43,000	9,000	401,000	519,000	−13,000
Atlantic	11,731,000	754,000	.....	1,108,000	411,000	14,283,000	12,404,000	1,852,000
Latin America	6,299,000	209,000	.....	1,062,000	94,000	8,396,000	9,167,000	−765,000
Pacific	7,498,000	830,000	.....	921,000	52,000	9,694,000	7,849,000	1,845,000
Panagra	1,033,000	54,000	.....	193,000	11,000	1,429,000	1,609,000	−186,000
Resort	.....	.....	.....	.....	418,999[1]	420,397	407,748	12,649[3]
Trans Caribbean	454,915	.....	62,910[2]	.....	36,854	578,301	536,942	84,916
Trans World	5,723,974	637,272	466,523[2]	.....	246,220	7,422,652	6,168,153	1,305,448
United	1,600,264	59,116	41,674[2]	.....	.....	1,714,676	1,187,963	478,982
Western	406,669	4,858	15,806[2]	.....	.....	429,333	367,335	56,584
LOCAL SERVICE								
Allegheny	755,346	8,101	22,417	23,783	1,180[1]	1,097,640	1,195,458	−97,818[3]
Bonanza	395,341	4,368	2,811	5,861	2,542	606,477	625,758	−39,026
Central	196,201	5,235	1,428	7,424	1,216	443,597	470,907	−27,310[3]
Frontier	496,550	13,820	5,000	27,538	9,185	1,083,880	1,139,144	−69,087
Lake Central	233,269	6,404	9,938	.....	.....	399,171	399,214	−43[3]
Mohawk	639,985	12,060	12,263	10,925	6,458	846,809	910,828	−64,019[3]
North Central	976,278	31,648	18,000	22,068	21,962[1]	2,272,619	1,728,569	527,332
Ozark	624,824	12,045	19,178	21,532	1,721	966,179	1,015,154	−48,975[3]
Pacific	530,760	9,948	3,373	4,223	46,271	797,608	954,630	−180,137
Piedmont[6]	599,686	9,649	11,631	9,615	10,639[1]	975,369	973,332	−24,262
Southern	363,226	14,398	7,879	11,627	665	615,585	686,171	−73,564
Trans Texas[6]	421,206	13,106	6,427	16,952	2,983	708,593	747,772	−42,008
West Coast	488,826	9,990	3,456	7,068	2,804	821,226	937,828	−116,602[3]
HAWAIIAN LINES								
Aloha	371,919	2,117	.....	6,389	1,149[1]	393,537	401,485	−7,548[3]
Hawaiian	535,236	3,707	.....	66,582	281,352[1]	905,766	859,153	26,414
CARGO LINES								
AAXICO	.....	.....	.....	.....	882,327	1,009,341	810,251	199,090
Aerovias Sud Americana	.....	.....	.....	115,713[9]	147,633	263,346	236,953	26,393[3]
Flying Tiger	.....	54,381	1,151,808[2]	.....	1,687,094	2,894,315	2,601,792	391,706
Riddle	.....	.....	.....	431,507	.....	433,862	594,347	−160,485[3]
Seaboard & Western	.....	.....	.....	.....	.....	1,640,431	2,196,092	−555,661[3]
Slick	.....	.....	.....	.....	1,446,342	1,474,479	1,315,062	159,147[3]
HELICOPTER LINES								
Chicago Helicopter	165,548	196,282[4]	.....	.....	.....	363,233	279,860	81,352
Los Angeles Airways	19,320	12,871	23,343[5]	.....	289	131,044	116,745	14,314
New York Airways	98,852	5,739	4,611	3,123	.....	299,179	304,616	−7,974
ALASKAN LINES								
Alaska Airlines	150,639	62,427	1,141	49,329	210,467	663,040	643,561	208,927
Alaska Coastal	69,585	9,373	.....	8,404	3,179	160,844	186,676	−25,831[3]
Cordova	8,979	7,165	.....	8,089	30,700	104,848	96,971	6,154
Ellis	52,394	6,000	7,575[2]	.....	196	110,523	95,736	14,787[3]
Northern Consolidated	53,383	58,036	.....	32,828	18,647[1]	255,815	248,482	7,333[3]
Pacific Northern	420,884	77,751	1,952	96,372	13,742	839,709	840,460	−14,932
Reeve Aleutian	110,507	37,356	.....	41,181[7]	32,805	224,108	181,174	41,442
Western Alaska[8]	8,628[5]	3,707	.....	2,534[7]	1,981	33,699	25,050	2,996[3]
Wien Alaska	59,681	65,353	.....	34,167	58,936	347,775	359,008	−11,233[3]

[1] Non-scheduled transportation [2] Property figure [3] Operating profit or loss [4] Includes federal subsidy
[5] Express & excess baggage [6] Airline division [7] Freight & excess baggage [8] Feb. 27, 1960 to Apr. 30, 1960
[9] Common Carriage

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

Airline Officer Salaries Filed With CAB

Slick Airways, Inc.—**E. F. Slick**, chairman of the board, no salary, bonus or indirect compensation, $12,721 expenses, 171,283 shares of common stock and $1,167,000 worth of company debt securities; **T. B. Slick**, director, no salary, bonus or indirect compensation, $647 expenses, 54,545 shares of common stock and $500,000 worth of company debt securities; **L. J. Moorman, Jr.**, director, no salary, bonus or indirect compensation, $1,217 expenses and one share of common stock; **C. F. Urschel**, director, no salary, bonus or indirect compensation, $507 expenses and 2,500 shares of common stock; **F. S. Borum**, director (resigned 11/30/59), no salary, bonus, indirect compensation, expenses or stock; **D. E. Bright**, director, no salary, bonus or indirect compensation, $1,518 expenses and no stock.

S. Marcus, director (resigned 10/7/59), no salary, bonus, indirect compensation, expenses or stock; **S. R. Milbank**, director, no salary, bonus or indirect compensation, $159 expenses and 200 shares of common stock; **R. G. Woods, Sr.**, director, no salary, bonus, indirect compensation or expenses and one share of common stock; **J. E. Parker**, director, $25,000 salary, no bonus or indirect compensation, $11,131 expenses and 8,500 shares of common stock; **W. E. Hollan**, director, no salary, bonus or indirect compensation, $630 expenses and two shares of common stock; **D. W. Rentzel**, director, $8,000 salary, $12,000 bonus and indirect compensation as a consultant, $20,500 expenses and no stock.

A. L. Butler, director (entered office 9/9/59), no salary, bonus, indirect compensation or expenses and 300 shares of common stock; **W. E. Miller**, assistant secretary and director, no salary, bonus or indirect compensation, $369 expenses and 2,500 shares of common stock; **A. W. Johnson**, executive vice president and director, $25,000 salary, $3,000 bonus and indirect compensation, $6,926 expenses and 700 shares of common stock; **H. P. Huff, Jr.**, vice president, $22,308 salary, $2,000 bonus and indirect compensation, $5,543 expenses and no stock; **J. H. Malone**, assistant treasurer, $11,472 salary, $1,000 bonus and indirect compensation, $3,331 expenses and no stock; **J. W. Walbert**, secretary and director (resigned 5/5/59), $1,350 salary, no bonus or indirect compensation, $843 expenses and no stock.

Following firms were paid for services rendered during 1959: **Steptoe & Johnson**, legal, $50,561; **Harold Wein**, consultant, $12,631; **Price Waterhouse & Co.**, auditing, $22,100.

Alaska Airlines, Inc.—**C. F. Willis, Jr.**, president and director, $29,555 salary, $32,250 bonus and indirect compensation, $9,041 expenses and 42,000 shares of common stock; **R. W. Gilbert**, senior vice president, secretary and director, $17,333 salary, $100 bonus and indirect compensation, $5,802 expenses and 500 shares of common stock; **R. H. Herrnstein**, treasurer and comptroller, $12,000 salary, no bonus or indirect compensation, $685 expenses and 500 shares of common stock, **LeR. Peterson**, vice president-services, $12,000 salary, no bonus or indirect compensation, $3,297 expenses and 500 shares of common stock.

Following directors were not paid a salary: **J. J. Clark**, $250 bonus and indirect compensation, $713 expenses and 100 shares of common stock; **D. M. Kendall**, $100 bonus and indirect compensation, no expenses and 10 shares of common stock; **G. C. Kinnear**, $150 bonus and indirect compensation, $105 expenses and 1,000 shares of common stock; **J. G. Larson**, $50 bonus and indirect compensation, $165 expenses and 100 shares of common stock; **E. J. Rusing**, $100 bonus and indirect compensation, $183 expenses and 1,000 shares of common stock; **J. Walker, Jr.**, $150 bonus and indirect compensation, no expenses and 35,195 shares of common stock; **F. C. LaGrange**, (resigned 9/25/59) $150 bonus and indirect compensation, no expenses and 100 shares of common stock; **K. N. Lesh** (resigned 3/17/59), no bonus, indirect compensation, expenses or stock; **R. W. Marshall** (resigned 8/10/59), $150 bonus and indirect compensation, no expenses and 100 shares of common stock.

Following firms were paid for services rendered during 1959: **Booke & Co.**, stockholder relations, $7,728; **Pogue & Neal**, legal, $13,447; **White & Case**, legal, $8,370; **Williams & Kinnear**, legal, $24,998; **Alan Innes Taylor**, tour organization, $5,500; **Lybrand, Ross Brothers & Montgomery**, auditing, $12,297; **Georgeson & Co.**, corporate stockholder services, $6,827; **Grant Advertising, Inc.**, advertising, $158,612.

Alaska Coastal Airlines (carrier is a partnership)—**S. B. Simmons**, co-manager, $20,482.39 salary (includes $1,502.39 vacation pay for vacation not taken) and $2,735.89 expenses, **O. F. Benecke**, co-manager, $18,980 salary and $1,281.86 expenses.

Following firms were paid for services rendered during 1959: **Theodore I. Seamon**, legal retainer and expenses, $11,936.69; **Edgar M. Queeny**, engineering rights for conversion of one Cons. 28-5ACF, $15,000.

Cordova Airlines, Inc., (carrier did not list bonus, indirect compensation or expenses)—**M. K. Smith**, president, general manager and director, $20,000.16 salary and 18,050 shares of common stock; **R. B. Borer**, vice president and director, no salary, holding 200 shares of common stock; **G. Dillard**, secretary, treasurer and director, $15,708.39 and 200 shares of common stock; **D. P. Swanson**, vice president-operations (resigned 6/23/59), $6,582.12 salary and no stock; **A. L. Martin**, director, no salary, holding 2,500 shares of common stock; **A. C. Swalling**, director, no salary, holding 2,500 shares of common stock.

Following firms were paid for services rendered during 1959: **O'Grady & Marshall**, legal, $8,043.31; **Theodore I. Seamon**, legal, $5,000; **Rettig, Scott & Co.**, auditing, $8,223.14.

Ellis Air Lines, Inc., (carrier did not list bonus or indirect compensation)—**R. E. Ellis**, president, general manager and director, $16,200 salary, $1,200 expenses and 21,212 shares of common stock; **G. A. Bodding**, vice president-operations and director, $15,750 salary, $400 expenses and 8,528 shares of common stock; **N. T. Gerde**, secretary and director, $15,150 salary, $400 expenses and 4,707 shares of common stock; **C. D. Linder**, treasurer, $7,900 salary, $300 expenses and 43 shares of common stock; **W. A. Nebel**, director, $12,300 salary, $400 expenses and 2,604 shares of common stock; **J. L. Sherman**, vice president-maintenance and director, $12,650 salary, $700 expenses and 8,075 shares of common stock; **K. J. Vanderweele**, director, $9,900 salary, $300 expenses and 1,945 shares of common stock; **J. Diamond**, director, $14,060.83 salary, $500 expenses and 845 shares of common stock.

Stump & Baily, legal counsel, were paid $6,120 for services rendered during 1959.

Northern Consolidated Airlines, Inc., (carrier lists director's fees in lieu of bonus and indirect compensation)—**R. I. Peterson**, president, general manager and director, $25,000 salary, $1,200 fee, $3,394.03 expenses, 219,070½ shares of common stock and $8,300 worth of company debentures; **S. B. Fitzhugh**, vice president, treasurer and director, $16,000 salary, $1,200 fee, $1,215.52 expenses, 16,403 shares of common stock and $1,600 worth of company debentures; **V. R. Davis**, secretary and director, $12,000 salary, $600 fee, $1,049.06 expenses and 593½ shares of common stock; **M. A. Peterson**, assistant secretary, $4,800 salary, no fee or expenses and 54,000 shares of common stock; **G. R. Unwin**, assistant treasurer, $10,587.50 salary, no fee, $401.61 expenses, 7,575 shares of common stock and $3,200 worth of company debentures.

Following directors were not paid a salary: **R. G. Miller**, chairman of the board, $1,650 fee, no expenses and 44,586½ shares of common stock; **C. J. Johnson**, $700 fee, no expenses and 1,150 shares of common stock; **A. Olsen**, no fee or expenses, holding 7,201 shares of common stock; **D. G. Rupe**, no fee or expenses, holding five shares of common stock and 42,450 shares of common stock in name of others.

CAB Approves Hughes-TWA Pact, Permitting 707, 880 Purchases

Washington—Civil Aeronautics Board has approved a $260 million financial agreement between the Hughes Tool Co. and Trans World Airlines which will permit the airline to purchase 25 Boeing 707 and 20 Convair 880 jet aircraft.

Twenty of the Boeings are currently being leased by TWA from Hughes and are included in the financing. Hughes will assign its interest and contract rights in the remaining aircraft to the airline under terms which call for TWA to sell $160 million in 5¼% bonds to banks and $100 million in securities to the airline's stockholders. The offering to the common stockholders may take the form of common stock, convertible subordinated debentures or subordinated debentures with detachable common stock purchase warrants, the Board said.

Hughes also has guaranteed TWA a minimum return of $100 million in the event the airline's stockholders fail to subscribe to the full offering and also has agreed to lend the airline an additional $50 million to complete the financing plan and keep the carrier's net working capital above $10 million. Pending completion of these arrangements, Hughes will guarantee a short term $50 million bank loan for TWA with repayment included in the permanent financing.

Board members pointed out that Hughes' guarantee of a $100 million net return on the TWA stock transaction could possibly require the manufacturer to subscribe to 100% of the offering.

Should this happen, CAB said Hughes' interest in TWA would increase from the present 78% to 90%. Although the 12% gain would ordinarily give rise to questions of control relationship, the present overwhelming control of the airline by Hughes makes the possible stock gain insignificant, CAB said.

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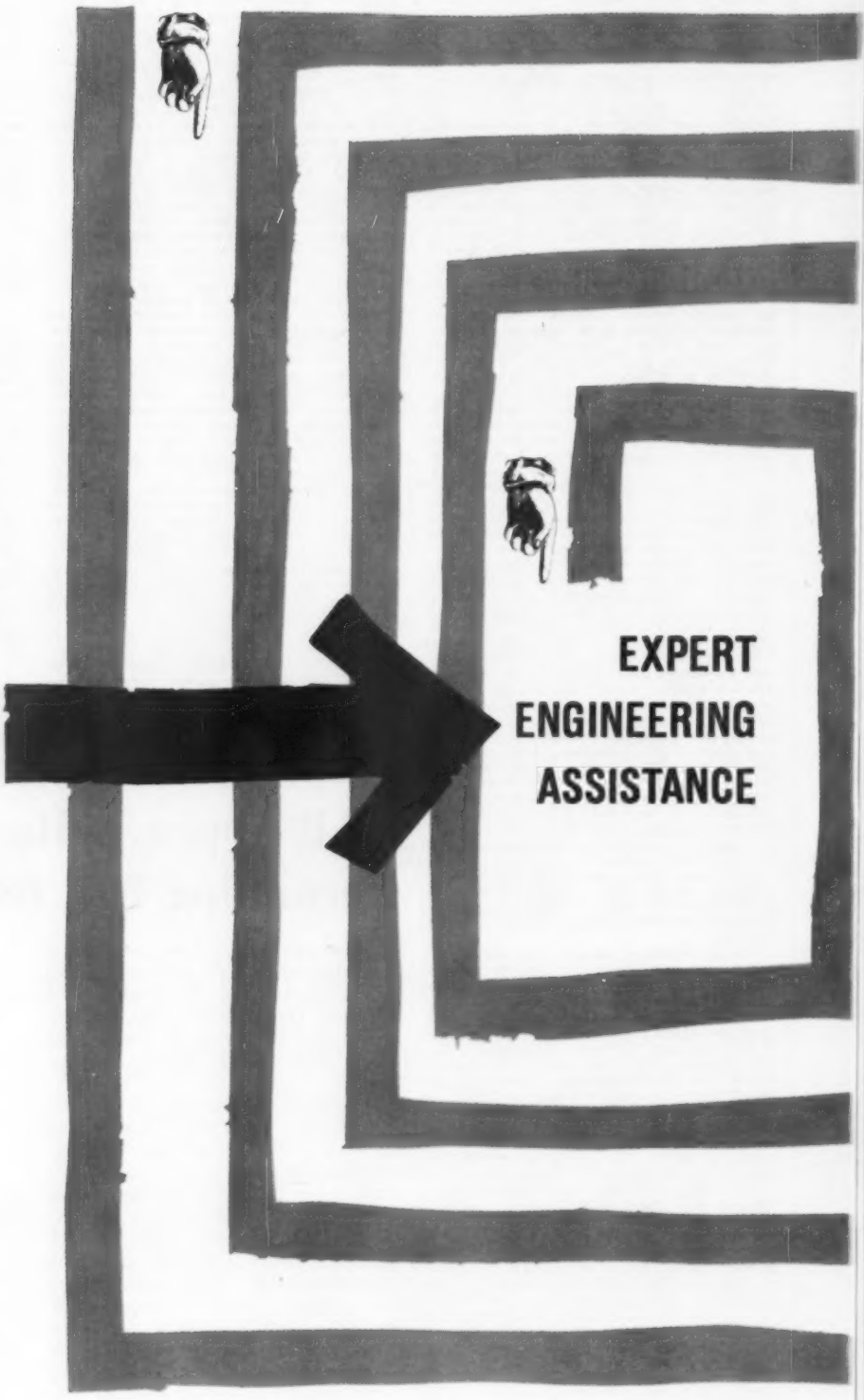

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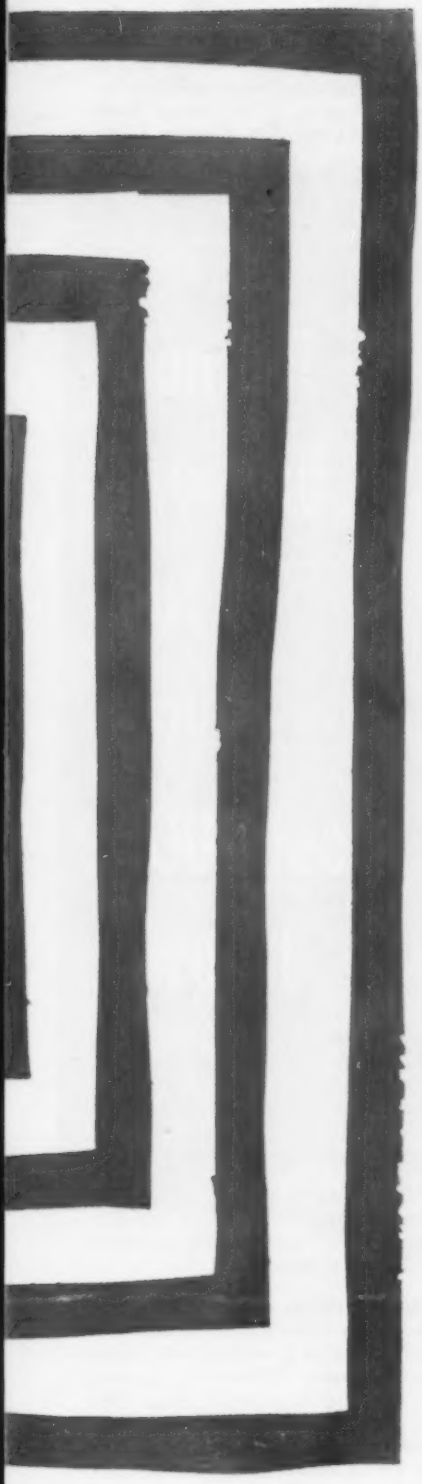

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J-92800

MEET SOME OF THE AIRCRAFT/MISSILE/SPACE SPECIALISTS BACKING UP THE WESTINGHOUSE SALES ENGINEER:

A. M. Bruning, Engineer-In-Charge, Advanced Development Group
Age: 33
B.E., Johns Hopkins, 1949
M.S., Mathematics, University of Pittsburgh, 1956
Specialties: Arc Heated Aerodynamic and Thermodynamic Test Facilities, MHD Research Facilities
Years with Westinghouse: 8

W. J. Walker, Engineer-In-Charge, Aviation Facilities Group
Age: 42
B.S.M.E., University of Southern California, 1949
Specialties: Wind Tunnels, Sonic Fatigue Test Facilities, Hardened Base Equipment, Launchers
Years with Westinghouse: 11

R. A. Feranchak
Age: 29
B.S.E.E., Youngstown College, 1952
Specialties: Arc Heated Aerodynamic and Thermodynamic Test Facilities, Explosive Forming, Rotating Equipment Test Stands
Years with Westinghouse: 7

R. F. Leopa
Age: 29
B.S.E.E., Lafayette College, 1953
Specialties: Military Power Plants, Radar Antenna Drives
Years with Westinghouse: 6

P. J. Hawkshaw
Age: 36
B.S.E.E., Catholic University, 1950
Specialties: Continuous-Flow and Hot Shot Wind Tunnels, Explosive Forming
Years with Westinghouse: 9

J. McDonald
Age: 43
A.B., Chemistry, Engineering, Physics, University of California, 1938
Specialties: Arc Chamber and MHD Generator Development
Years with Westinghouse: 13

H. C. Lee
Age: 40
B.S.E.E., Chiao Tung University (Shanghai), 1942
M.S., Engineering, Cornell University, 1949
Ph.D., Cornell University, 1951
Specialties: Arc Chamber and MHD Generator Development
Years with Westinghouse: 2

H. A. Zollinger
Age: 30
B.S.E.E., Michigan College of Mining and Technology, 1951
M.S.E.E., University of Pittsburgh, 1958
Specialties: Drive Systems for Loaders, Elevators, Erectors and Launchers
Years with Westinghouse: 9

Westinghouse

AIRLINE OBSERVER

► Watch for another bid by The Netherlands for additional operating rights for KLM Royal Dutch Airlines within the U.S. Principal goal is a popular route to the U.S. West Coast, a demand that has deadlocked previous negotiations between the two countries. Dutch again will back their efforts with top-level government pressure on the U.S. KLM now serves New York, Miami and Houston on its routes to the U.S.

► **Philippines, meanwhile, has extended operating permits of U.S. carriers into Manila for four months. Permits expired July 3, after U.S. and the Philippines failed to reach accord in renegotiating terms of the bilateral transport agreement between the two countries. Philippines will also apply strong government pressure on the U.S. in efforts to restrict capacity of flights serving Manila. Philippine President Carlos Garcia discussed the issue with President Eisenhower during his recent visit to Manila, but no firm commitments were made. Philippine government is pushing the inauguration of a transpacific route as part of national policy. Legislation has been passed granting subsidy to the carrier for any losses it may sustain in the proposed operation. Mexican bilateral agreement which expired June 30 has been extended to Aug. 15.**

► Lockheed Electra turboprop structural fixes will require approximately 20 days per aircraft. Program was scheduled to start last week at Burbank, Calif., where all modification work is to be done.

► **Ethiopia has signed bilateral air transport agreements with Ghana, Guinea and Liberia to permit first trans-African scheduled air service above the equator. At the present time, flights between east and west Africa are completed by connections at Paris, Frankfurt or Athens. Route will be operated by Ethiopian Airlines and Ghana Airways.**

► Panagra raised its twice weekly Douglas DC-8 schedule from New York to Buenos Aires July 1 to four weekly flights with the delivery of another DC-8. Approval of the service into Buenos Aires was received only at the last minute. U.S.-Argentine bilateral talks currently are deadlocked over flight frequency issues. Pan American World Airways has had, in effect, to give up two piston-engine flights for one jet flight into Argentina in the past. Panagra and the Argentines still are negotiating over conditions, but for the present Panagra is operating its usual DC-6B and DC-7 schedule.

► **United Air Lines began first Boeing 720 medium-range jet transport service last week, four days after the airplane was certificated by the Federal Aviation Agency. Initially, the airplane will be operated on the carrier's Chicago-Denver-Los Angeles and Pacific Coast routes.**

► Lagging airport development still stands as a major jet service problem in South America. Lengthening of runways at Santiago, Chile, is not scheduled to begin until next year. At Lima, the new international airport is ready, but highways from the city will not be completed for another month. Meanwhile, jet transports are landing at the Las Palmas military airfield. Pilots have been asked to land one-third of the distance down the runway since the heat of the turbojet engines on takeoff has caused a washboard effect on the blacktop runway surface.

► **Transcontinental S. A. of Argentina will honor American Express Co. credit cards for the purchase of transportation between the U. S. and South America.**

► RAE system, a British-developed visual glide path system of indicator lights, is being considered for adoption by Federal Aviation Agency Administrator E. R. Quesada. System consists of 12 light units which are arranged in bars with three units on each side of the runway 750-ft. from the threshold and identical units 1,200-ft. from the threshold. Lights are considered an essential aid in night and low visibility landings. The system has been recommended by FAA's Bureau of Research and Development as a national standard.

► **Federal Aviation Agency air route traffic control centers last week began using 300 new radio frequency assignments for en route traffic control. An additional 200 frequency assignments will be added within the next 90 days.**

SHORTLINES

► **Aerolineas Ini y Cia.** of Argentina has been accepted as a member of the International Air Transport Assn. Ini is the 12th South American airline to join the international airline association. Ini operates Douglas DC-6 aircraft from Miami to Panama City, Panama, Lima, Peru, Santiago, Chile and Buenos Aires with intermediate stops.

► **American Airlines** scheduled to introduce the Boeing 720 turbojet transport July 31 on its Cleveland-St. Louis-Los Angeles route. The new aircraft, which will fly one daily round trip on the route, will carry 98 first and tourist class passengers.

► **Eastern Air Lines planned to put the** first of 10 Douglas DC-7B aircraft seating 24 first class and 48 coach passengers into service last week. The DC-7Bs were converted from an all-first class configuration which seated a total of 69 passengers instead of the present 75. The converted aircraft will eventually be used on services to 15 cities on Eastern's routes. Work on the aircraft was done at Eastern's Miami maintenance base.

► **Keystone Helicopter Corp.** of Philadelphia has signed a two year contract with an American oil company to provide aerial resupply services in Boliva. Keystone will operate the service with two Fairchild C-82 transports. All maintenance will be performed in South America. Keystone recently hired three pilots and two mechanics for assignment to Bolivia, and air service is scheduled to begin this month.

► **Pan American World Airways** ordered three additional Boeing 707 Intercontinental turbojet transports to be used on round-the-world services. The $16.5 million order is scheduled for delivery early in 1961 and brings to 53 the number of turbojet transports Pan American has in operation or on order.

► **Qantas Empire Airways** plans to introduce a sixth weekly round trip Boeing 707 service between San Francisco and Sydney Sept. 1.

► **Trans Caribbean Airways** has received a six month extension of its authority to operate flights from San Juan, Puerto Rico, to Aruba, Netherlands Antilles, from the Civil Aeronautics Board. The carrier has been flying two round trips a week for the past six months from New York to San Juan and on to Aruba. Pan American World Airways opposed the extension, and Board Vice Chairman Chan Gurney dissented from the extension decision.

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The finest medium range jetliner the world over

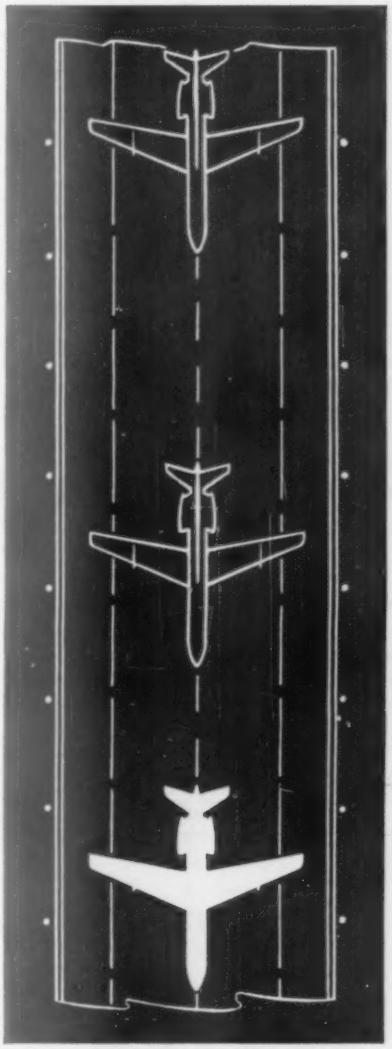
Can get into and out of any 5000 foot airport

Now, by flying Caravelles, airlines can provide pure jet service on many routes where the big jets are barred.

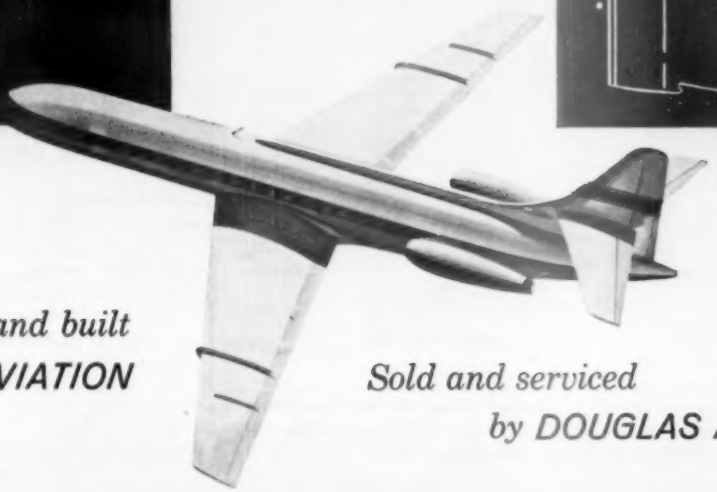
Not only does Caravelle have short runway requirements, but it can operate with minimum airport facilities. It carries its own built-in loading stairs and can start its twin-jet engines from its own airborne batteries.

Caravelle can fly profitably over routes from 200 to 1400 miles with as few as 28 passengers aboard. High rates of climb and descent plus jet speeds result in short block times.

It fits the Douglas tradition ... dependable, durable, and an airline profitmaker.



LANDING DISTANCE
3600 FEET



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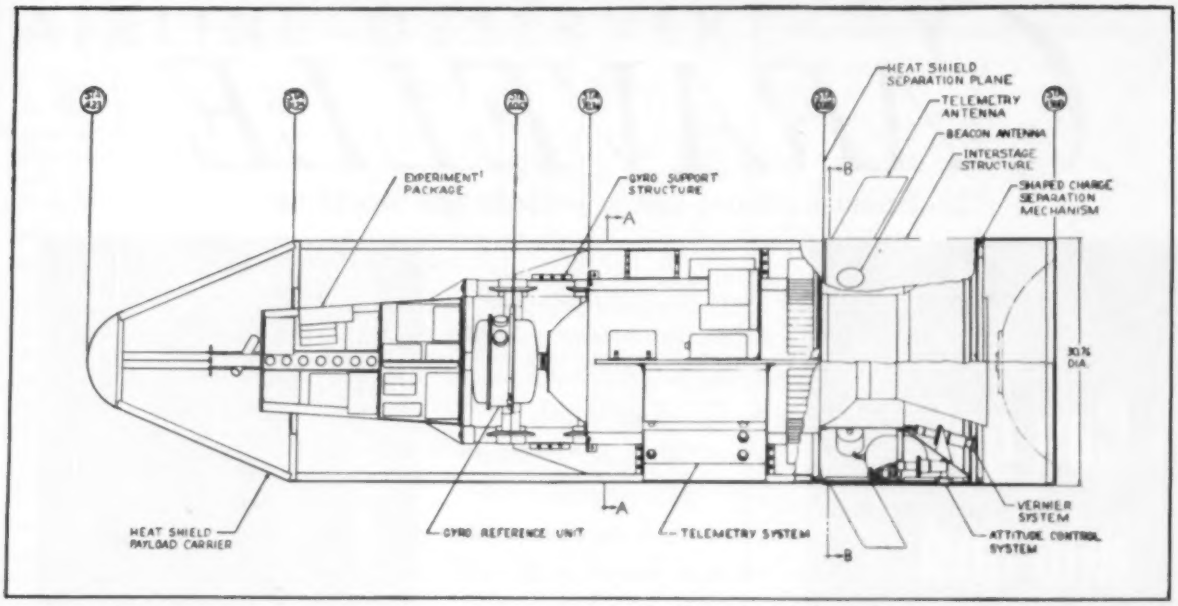


ATTITUDE-STABILIZED payload carrier for the 1-2-3-4 version of HETS 609A is detailed above. The Allegany Ballistic Laboratories X-248 final stage motor can be replaced by extra payload in the three-stage configuration.

Scout Variant to Have Dyna-Soar Role

By Russell Hawkes

Newport Beach, Calif.—Multi-versioned Air Force Hyper-Environmental Test System (HETS) 609A, now beginning a series of nine development flights from Cape Canaveral, Fla., is slated for an important role in the Dyna-Soar program and is a strong competitor for at least three other important roles.

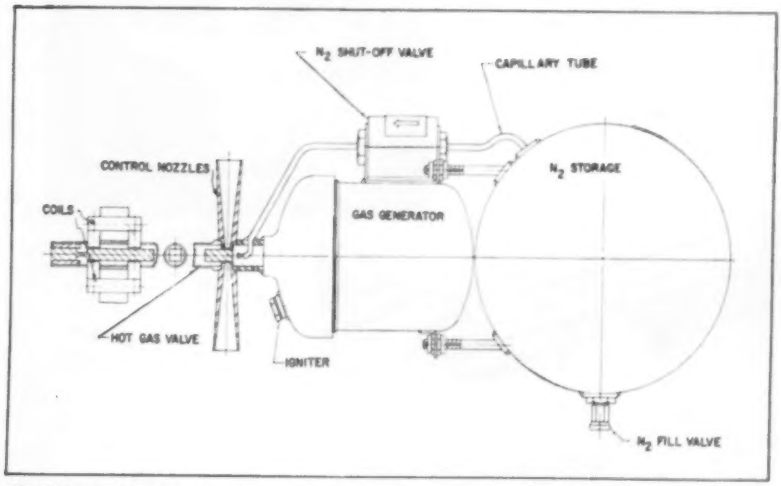
HETS 609A is a family of variants of the National Aeronautics and Space Administration's Scout. Officials of Ford Motor Co.'s Aeronutronic Division, holder of contracts for system integration and payload carrier design, told AVIATION WEEK that a HETS 609A vehicle is intended to carry a 500-lb. model of Dyna-Soar to an altitude of 300,000 ft. and a speed of 20,000 fps. sometime next spring. Dyna-Soar model flights originally were planned for this year but reportedly slipped about a half year because of some delayed decisions by Department of Defense.

Another group of between five and nine development shots may be added to the nine already scheduled. Some of these would overlap "operational" test and research flights scheduled to begin after the first of the year if the expected funding is received. Aeronutronic officials see a need for 62 operational HETS flights in 1961.

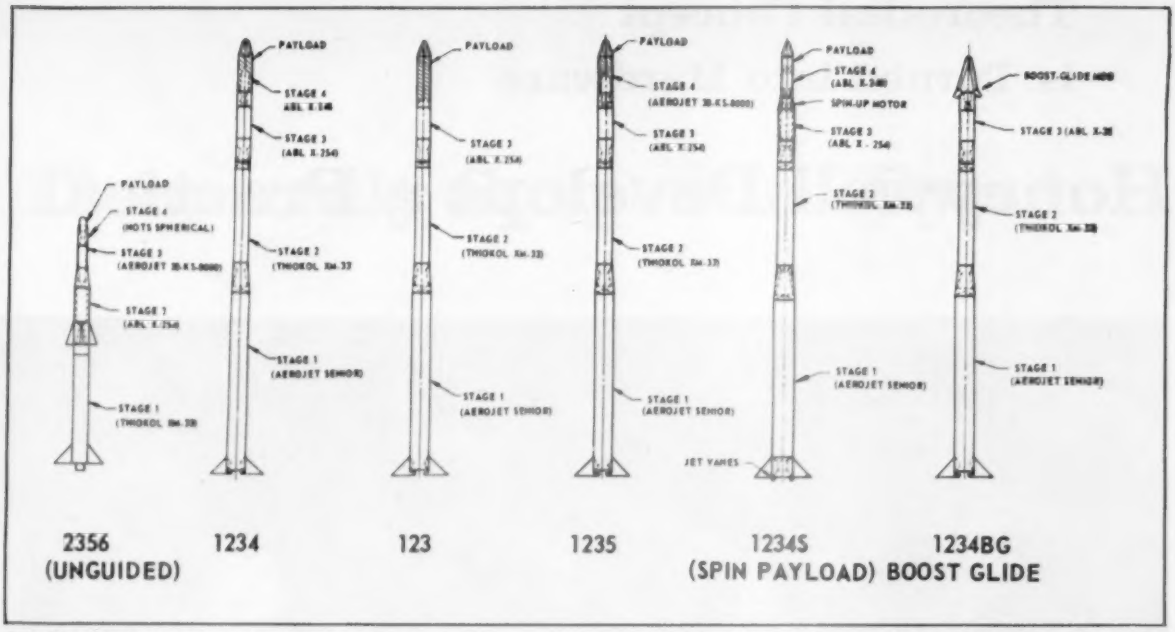
Three of the programs for which HETS 609A is competing are:

- **Missile-borne emergency** radio communications relay to back up strategic global communications system 480L. Launched into a vertical or ballistic trajectory, the relay could be used to penetrate "Argus effect," interference of nuclear blasts or defeat enemy jamming during the crucial first hours of a war.
- **Lightweight version** of Transit navigation satellite now being considered by Navy.
- **Flight testing** of Avco expanding skirt drag brake as a means of controlling re-entry trajectories.

Several planned HETS vehicles have been allocated for feasibility tests of the missile relay idea. Satellite communications relays offer many of the same advantages as missile relays, plus longer life, but are more accessible to



FOURTH STAGE two-level control system is powered either by solid propellant gas generator or by compressed nitrogen exhausting through a pair of opposed nozzles. Flutter valve pulse-width modulates flow of hot gas to opposed nozzles.



SIX CONFIGURATIONS of HETS 609A. The basic 1-2-3-4 configuration differs from NASA's Scout in having a 30-in.-dia. payload carrier rather than a 20-in. one. The 1-2-3-4S configuration is nearly identical to Scout.

enemy countermeasures because of their fixed schedules.

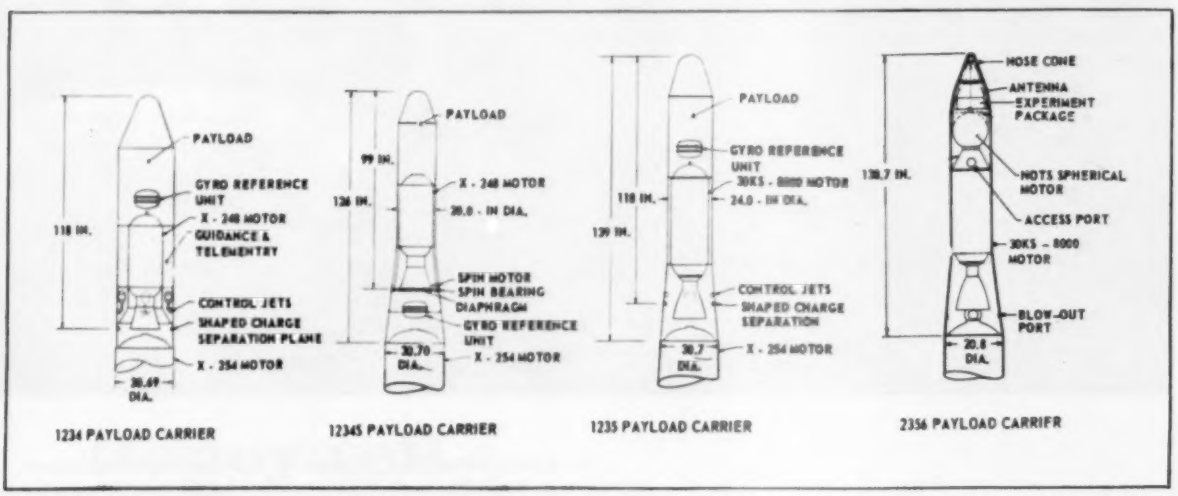
Aeronutronic officials believe that the recent stretchout of the Project Steer low altitude communications satellite makes acceptance of the missile relay system more probable. Defense Department officials apparently favor going directly to Project Advent with a 22,000-mi., earth rotation-synchronized, equatorial orbit without buying satellite of lesser capability. Realization of the Advent plan is far enough away to improve the hopes for cheaper, easier projects with some of the same advantages, Aeronutronic engineers believe.

Argus effect of radiation upon communications is worst in the low frequencies commonly used for long range radio communications and is less in the high radio frequencies, becoming only moderate at ultra-high frequency. These frequencies are seldom used for long range communications because they are limited to line-of-sight range. The missile relay would make them usable by operating at an altitude high enough to be within line-of-sight of nearly half the earth at apogee.

Positive control communication with Strategic Air Command bombers in flight is one important application of the missile communications relay. The system would assure transmission of "go" orders to air alerted bombers at the outbreak of war. The missile relay probably would be fired into a northbound ballistic trajectory with a maximum altitude which might be as high as 7,600 naut. mi. if HETS is used.

Link Stations

In transoceanic communications, the HETS-boosted relay could link stations separated by a distance of 6,000 mi. for a 2-3 hr. period. Stations 8,500 mi. apart can communicate briefly when the relay



FOUR PAYLOAD CARRIERS of HETS 609A. A major difference between 1-2-3-4S (Scout) and the basic 1-2-3-4 altitude-stabilized configuration is the movement of the Minneapolis-Honeywell gyro reference unit from the interstage structure which remains attached to Stage Three, into the final stage.

Theoretical Concept is Turned into Hardware

Honeywell Develops a Practical

Mr. Robert Maze, Chief Engineer of Honeywell's Marine System Group, is reflected in the highly polished beryllium spherical rotor of Honeywell's new Electrically Suspended Gyro. The Marine System Group is a special Honeywell "task force" assigned to guide the ESG program through its rapid development.

Electrically Suspended Gyro!

Advanced new gyro concept using friction-free spherical rotor will bring greater accuracies to marine and airborne inertial systems, and northfinder systems.

Honeywell's leadership in the field of inertial systems and sensors is further demonstrated with advances on its Electrically Suspended Gyro. Here the company has taken a theoretically superior gyro concept, conceived by Dr. Arnold Nordsieck of the Univ. of Illinois, and turned it into practical development hardware. This new ESG concept is being developed under funding from the Navy Special Projects Office and Wright Air Development Division. Recognizing the unique capabilities of this new device, Honeywell has assigned a special task force group to continue to press the development of the gyro and the inertial system designed to take fullest advantage of the gyro's capabilities. In the near future, the Honeywell inertial system incorporating the ESG will be put into its test phase.

This new gyro has only one moving part, a spherical rotor, electrically suspended in a self-contained, hard vacuum to completely isolate the sensing element. The spherical rotor is made of beryllium, machined and polished to tolerances of a few millionths of an inch! The gyro is brought up to speed by electronic means, then coasts throughout long periods of operation. Reference information is picked off optically.

Honeywell, because of its experience in gyro components and systems, has already solved many problems related to this new gyro concept.

1. **Precision Machining of Problem Metals:**
   In order to take advantage of beryllium's high material stability, Honeywell has developed manufacturing techniques that overcome beryllium's brittleness and toxicity problems.

2. **Precision Ceramics:**
   Honeywell has perfected the techniques for firing and machining the precision ceramic envelope, and for overcoming the difficulties in fabricating the ceramic-to-metal seals.

3. **System Integration:**
   Honeywell, with its advanced system experience, has created a new inertial system to take fullest advantage of the capabilities of this new Electrically Suspended Gyro.

For more information on Honeywell's new products, write to Minneapolis-Honeywell, Dept. AW-7-111, Minneapolis 8, Minn.

Precision ceramic envelope receives a final machining after being fired at a temperature of 1300° C. Diamond grinding and ultrasonic drilling are utilized in finishing the envelope.

Beryllium rotor, after being machined, ground and polished, is checked for sphericity to tolerances of a few millionths of an inch!

Honeywell

H Military Products Group

Constant communication control of air fleets anywhere in the world, formerly possible only in military applications, is now available for all commercial aircraft with long range communication requirements.

The Collins design teams that developed global communication for the U.S. Air Force, Navy, and Marines are now introducing the 28,000 channel 618T HF SSB Transceiver to meet the increasing commercial aircraft need for reliability in extended range air-to-ground communication. Covering the entire 2-30 megacycle band, the 618T offers both AM and SSB performance. Simplied one-control operation selects any one of the 28,000 automatically tuned channels. Complete compatibility with existing military and commercial ground stations, both AM and SSB, is available for emergencies or for military mobilization. The 618T monitors Selective Calling frequencies in all three modes at all times.

A technique pioneered by Collins, single sideband provides dependable long distance communication that gives you twice the talking power of existing systems on only half the frequency bandwidth because all the output power is concentrated in less than half the frequency wave. The result is a powerful, long range low distortion signal, despite poor atmospheric conditions. Extended frequency stability enables 100 word per minute teleprinting transception anywhere in the world as accessory and ground facilities for these services are developed.

The 618T is transistorized, completely modularized, including power supply. It's lighter, smaller — 1 ATR case size.

The ground complement of the 618T can be selected from any of Collins SSB communication systems — from 500 watts to 45 kw, depending on range requirements.

FEATURES

- Spectrum conservation.
- Immunity to multipath distortion.
- Higher signal-to-noise ratio.
- Power output of 400 watts on SSB.
- Selectable upper or lower sideband.
- Stability of one part-per-million per month.
- Higher reliability with lower weight.
- Modular construction for maintenance and supply ease.
- Complete transceiver in a 1 ATR case.
- FAA TSO'd. Receiver certified to FCC radiation standards.

Available for August 1, 1960 delivery. Write or call Collins Aviation Sales, Cedar Rapids, Iowa, for information and complete technical specifications.

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HETS 609A Tentative Launch Schedule

Target Date	HETS Type	Mission
July, 1960	2-3-5-6	D-1 unguided probe to about 4,000 naut. mi. altitude, complete vehicle spin-stabilized.
July, 1960	2-3-5-6	D-2 unguided probe to about 20,000 naut. mi. altitude; vehicle same as D-1 but with half its payload.
Aug. 1960	1-2-3	D-3 guided, three stage high altitude probe.
Sept. 1960	1-2-3-4	D-4 guided, four-stage probe with attitude-stabilized final stage.
Oct. 1960	1-2-3-4	D-5 same as above.
Oct. 1960		D-6 guided three stage altitude probe.
Nov. 1960	1-2-3	D-7 guided three stage partial re-entry vehicle. The re-entry body will burn up before impact.
Dec. 1960	1-2-3-4S	D-8 orbital flight with spin-stabilized final stage. Vehicle is the same as NASA Scout.
Dec. 1960	1-2-3-4S	D-9 same as above.

is at its 7,600 mi. apogee. Since it is a one-shot venture, the missile relay gives the enemy less time to devise countermeasures and its trajectory makes it usable for nearly all its flight time. A satellite-borne relay is on the wrong side of the earth for half its orbital period. However, missile relays would be far too costly for permanent or long term use.

The HETS vehicle for the missile relay can be available by 1961. Aeronutronic engineers say no new electronic technology is needed to build the relay package; Bendix Systems Division is now developing it. It is to weigh about 25 lb. and its power requirement is set at about 100 watts. The ground antenna must have a gain of 32 db., but this can be had with existing 60 ft. parabolic tracking antennas. The station-relay and relay-station links would each have a bandwidth of 1.5 mc. accommodating 360 four kilocycle duplex voice channels, which Aeronutronic engineers say is ample capacity to replace all essential transoceanic communication systems.

Reaction Time

Reaction time of the relay's HETS vehicle can be less than five minutes. Its maximum acceleration would be less than 10g compared with 80g for some solid propellant rocket systems. This is a relatively simple load to deal with in the design of the electronics.

The first six HETS development firings are to be high altitude probes, the seventh is to be a partial re-entry test in which the vehicle will burn up before impact and the last two will be orbital flights. The series of nine is to be finished by the end of this year. Almost 50 different experiments were approved and submitted by Air Research and Development Command for inclusion in the payloads of the development vehicles. Many of these had to be dropped because of incompatibility with the payload carrier or other experiments.

While development of the family of vehicles is the primary aim of the nine authorized flights, the greater part of payloads will be reserved for experiments. This is possible because the similarity of the basic HETS vehicle to the NASA Scout enables USAF to use much NASA flight test data. Actually, more performance test instrumentation will be carried than was originally planned.

Schedule changes brought the two programs into the flight test phase closer together than expected.

Heavier Payload

Extra flight test instrumentation will make the first HETS payload twice as heavy as the otherwise identical second one tentatively scheduled to go later this month. The extra weight reduces the maximum attainable altitude by a factor of five. The second one is to reach an altitude of more than 20,000 naut. mi.

Tasks to be carried out during HETS 609A development flights include a series of investigations originally planned for the canceled Project Journeyman of Air Force Special Weapons Center.

To accommodate the Journeyman missions, three more flights are likely to be inserted in the nine-flight development series.

Aeronutronic started the HETS 609A program about a year ago with a survey of Air Force research needs and the modifications of the NASA Scout necessary to meet them. The lack of specialized carriers for military research and development payloads has caused many problems in the military space program.

Many experiments have been carried in piggyback payloads aboard ballistic missiles and other military vehicles, but the demand for transportation into space has exceeded the supply. In some cases, it has even been difficult to find room in the payload for elements of the strategic system being tested. Experimenters complains that sometimes they can get funds only if they have already been guaranteed space in a missile or satellite several months before the launch date. Project officers hesitate to promise room for experiments which may never be approved. Thus, much time and many valuable experiments may be lost. To keep technology advancing, Air Force officers called for a fleet of "space trucks" offering more certain transportation for military research payloads.

Capability Range

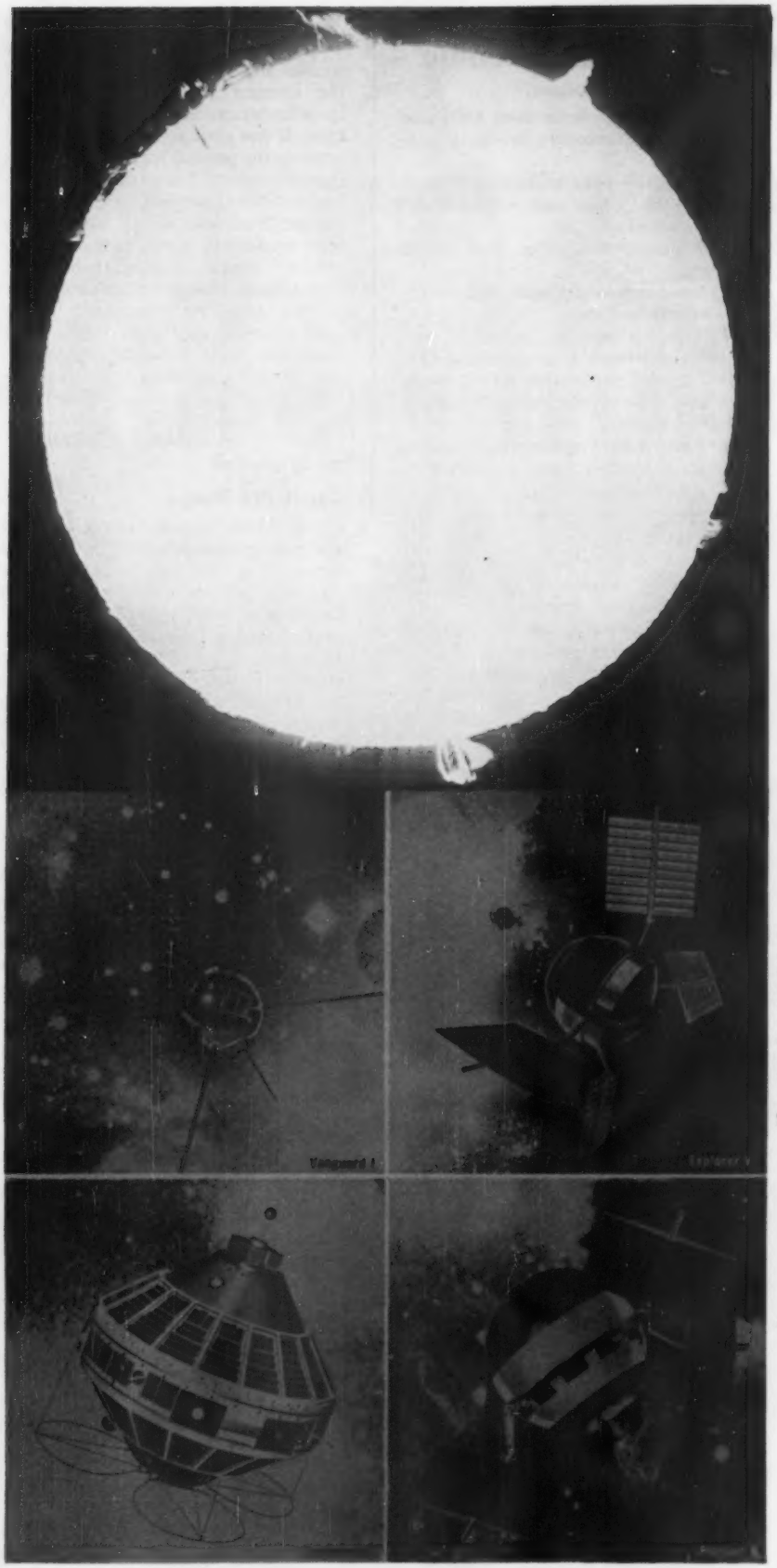
The survey turned up a need for a wider range of capabilities than that of Scout. The best way to obtain these and still achieve something like the economy of Scout seemed to be expansion of Scout's building block principle to include a larger number of staging combinations and payload carriers and the sacrifice of some performance to increase payload. Scout has about 10% higher apogee than the basic HETS if launched in a probe trajetory. An unfunded new motor for the fourth stage of HETS is designed to improve maximum altitude by 25% or payload by 150 lb.

Scout final stage is spin-stabilized and the vehicle is designed primarily for orbital missions. The HETS family is intended for vertical probes and perhaps for lunar probes. The performance-payload combinations of probe versions include:

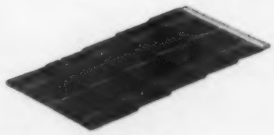
- **4,000 naut. mi. altitude** for spin-stabilized 100 lb. payloads.
- **30,000 naut. mi.** for 25 lb. payloads in the smaller unguided and spin-stabilized configuration.
- **Altitude of 1,500 mi.** for attitude-

HETS 609A Motors

- Aerojet-General Senior—Algol.
- Thiokol XM-33-E5—Castor.
  Thiokol XM-33-E3—Castor (with sea level nozzle).
- Allegany Ballistic Laboratories X-254-A1—Antares.
  Allegany Ballistic Laboratories X-254-A2—Antares (with thicker case).
- Allegany Ballistic Laboratories X-248-A5—Altair.
  Allegany Ballistic Laboratories X-248-A6—Altair (with thicker case).
- Aerojet 30 KS-8000.
- Naval Ordnance Test Station 100A—17-in. diameter spherical solid rocket.



Hoffman solar-power series.



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†A Patented Device (U.S. Patent No. 2,938,938)

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stabilized 500 lb. payloads. There are, at present, six versions of HETS using six standard stages and a variety of standardized hardware. Interstage structures are provided by Chance Vought Aircraft.

No version has more than four stages or fewer than three, but new ones could be designed.

Rocket Uses

Each of the six rockets used as HETS stages is assigned a single digit identification.

The combination of digits identifies the system and thus:

- **1-2-3-4 is the basic** four-stage HETS with an attitude stabilized final stage.
- **1-2-3-4-S (Spin)** has a spin-stabilized final stage and is identical to NASA Scout.
- **1-2-3 is a three-stage** vehicle with the fourth stage motor replaced by more payload. Performance, however, is sacrificed.
- **1-2-3-5 is similar** to 1-2-3-4 but with an improved, bigger final stage motor for better performance or additional payload.
- **1-2-3-4-BG (Boost Glide)** has the final stage replaced by the rocket-powered boost-glide (Dyna-Soar) experimental model.
- **2-3-5-6 is the four-stage** unguided altitude probe used in the first two flights. The first and second stages use the same motors as the second and third stages of the 1-2-3-4 HETS configuration.

To hold more payload, the final stage of the 1-2-3-4 version has been given a 30-in. diameter, compared with 20 in. for Scout and a performance penalty is paid.

Air loads on the big nose section and the airfoil of the boost-glide model have made the interstage structures and the case of the third stage stiffer. To improve stability, the base of the first stage has been flared and the increased volume between the nozzle and the skin is used to hold the control system hardware.

Stage One control is provided by movable aerodynamic fin tips and molybdenum vanes in the rocket exhaust. The fins and the vanes are bussed together mechanically. In Stages Two and Three, hydrogen peroxide rockets control pitch, roll and yaw.

Attitude Control

An unusual two-level attitude control is used in the final stage without spin stabilization. The high level control is used during the burning time of the final stage propulsion rocket to combat the relatively high overturning torque produced by its thrust and the low level control is used after burnout. Both methods make use of eight small

No aircraft rivet can match the features offered in the New Cherrylock* "2000" Series rivet.

Proven high sheet clamp-up—one rivet can be used for several material thicknesses, reducing stock requirements and lowering cost. Complete hole fill even in oversize holes, with uniform head seating, wide grip range and mechanically locked stem.

Easy, positive visual inspection—after the rivet is installed—is guaranteed by grip length markings on the head. Cherrylock rivets are installed with existing Cherry installation guns to give you better fastening at lower cost.

Available in:

A-286 Stainless Steel
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For technical data on the new Cherrylock "2000" Series rivets, write Cherry Rivet Division, Townsend Company, Box 2157-N, Santa Ana, Calif.

*Patent Pending

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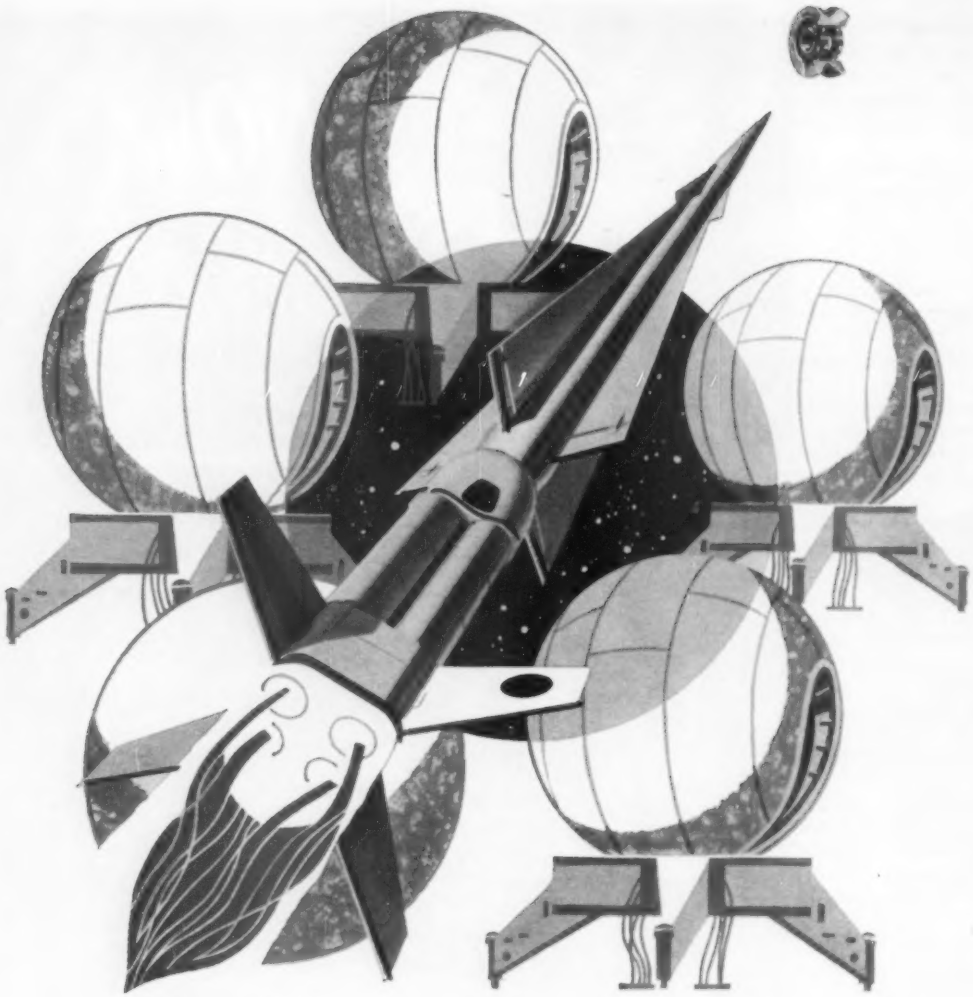
In Canada: Parmenter & Bulloch Manufacturing Company, Limited, Gananoque, Ontario



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ND Designs Assembly Savings Into Critical Miniature/Instrument Ball Bearings!

Helping customers *simplify* instrument assembly is a specialty of the N/D engineering group. How? Through *creative* Miniature/Instrument ball bearing application and design. Often, a new ball bearing design will produce assembly savings in excess of its additional costs. Integral ball bearings, too, very often cut down difficult and costly hand assembly of shaft and parts.

A timely example of N/D customer assembly savings can be seen in Nike Ajax and Hercules missile ground support. Here, *special* N/D Instrument ball bearings are now used in precision potentiometers. New Departure engineers recommended eliminating two *single row* instrument bearings, mounted in duplex and requiring precision spacer and separate guide roller. They replaced this assembly with a *special* N/D *double row* high precision instrument ball bearing with integral outer race guide roller . . . and shaft mounted with a nut. This one recommendation produced cost savings of over 400%! In turn, the customer was able to reduce the potentiometer selling price to the government. What's more, the New Departure Instrument Ball Bearings improved potentiometer reliability!

You can look to minimum assembly costs and unsurpassed *reliability*. Include an N/D Miniature/Instrument Bearing Specialist in your early design level discussions. For immediate information or assistance, call or write Department L.S., New Departure Division, General Motors Corporation, Bristol, Connecticut.

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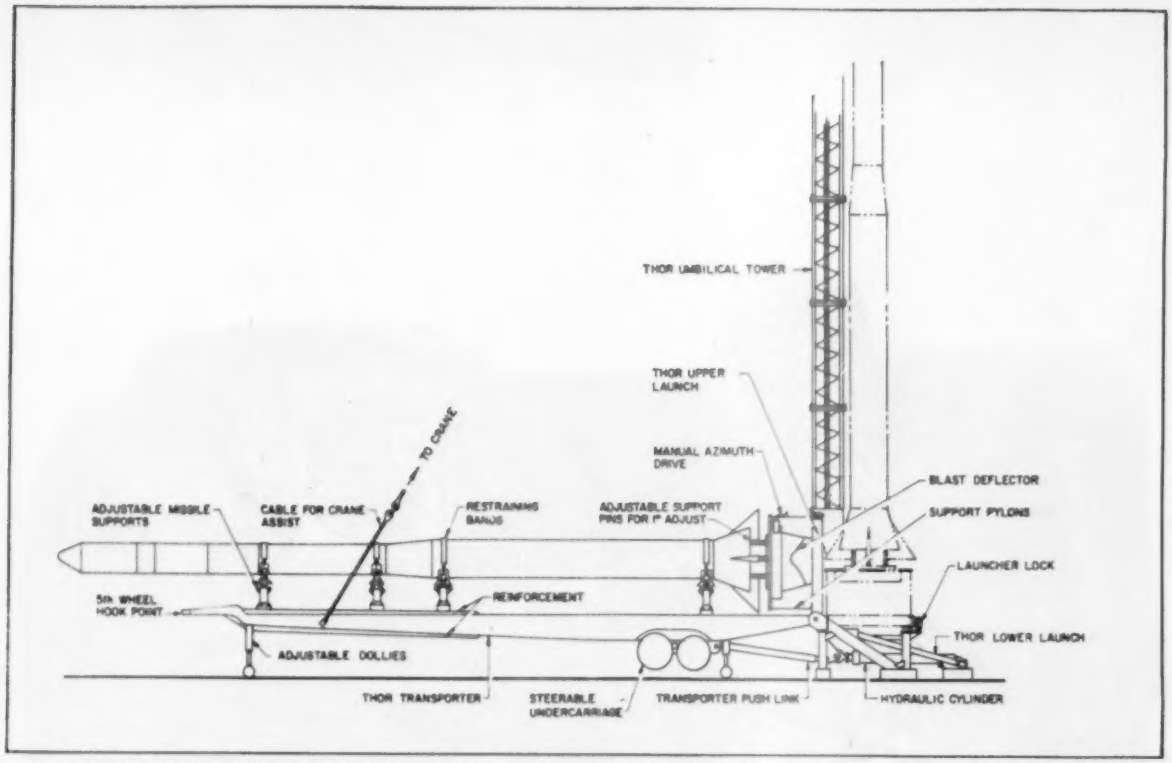

THOR LAUNCHER-TRANSPORTER has been modified for HETS 1-2-3-4 vehicles. Cable crane arrangement had to be added to lift the heavier research vehicle and blast deflector and support needed changes.

nozzles arranged on the aft end of the stage in pairs firing from opposite directions. Energy for high level operation comes from solid propellant gas generators producing as much as four pounds of thrust per nozzle. Compressed gaseous nitrogen produces up to $\frac{1}{8}$ lb. of thrust per nozzle in low level operation.

In high level operation, the flow of hot gas out the opposed nozzles is pulse-width modulated by a flutter valve, but cold gas for low level operation is controlled by a simple "on-off" action. The nitrogen is stored in standard 5-in. spheres at 3,000 psi. The system can provide attitude control for two full orbits and this period could be extended. The control system operates on commands of a Minneapolis-Honeywell autopilot similar to that of Scout, but shifted from the top of Stage Three into the payload carrier.

The unguided HETS 2-3-5-6 version is spun up at launch by jettisonable spin rockets. Canted aerodynamic fins on the first and second stages maintain the spin. The second stage burnout spin rate is about 180 rpm., which maintains the attitude of the third and fourth stage when they are launched from within the tubular heat shield which remains with Stage Two. Aeronutronic engineers say the maximum altitude of the 2-3-5-6 configuration can be extended to 180,000 naut. mi. by the use of improved propellants in the second and fourth stages. The 2-3-5-6 will be launched from a NASA-developed Sergeant launching boom.

Aeronutronic engineers estimate that less than 40 men will suffice to assemble, check out and launch any of the larger HETS 1-2-3-4 or 1-2-3-5 vehicles. A Douglas Thor transporter-launcher has been converted to handle the HETS vehicles. A cable crane arrangement had to be added to help the hydraulic system lift the 35,000 lb. solid propellant research vehicle.

SAC Teams Complete Space Crew Efficiency Test

Air Force volunteers have completed a 15-day work-rest tour in a simulated space cabin at Lockheed's Marietta, Ga., facility, as part of a Wright Air Development Division study on performance efficiency. Above is Capt. William Lane, a Strategic Air Command pilot from Eglin AFB, Fla., who worked a 4 hr. on and 2 hr. off shift around the clock for the 15 days. Lane, member of one of two SAC teams, operated a console to work problems of arithmetic and perception.

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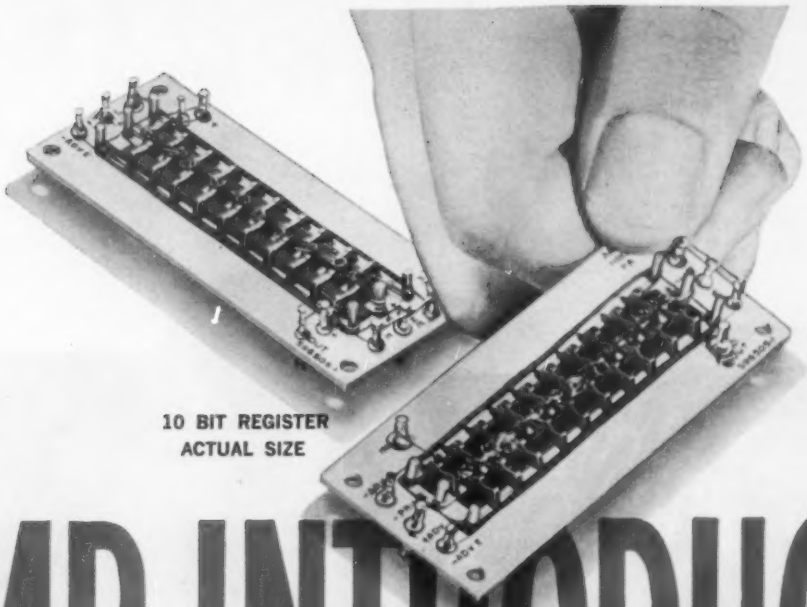

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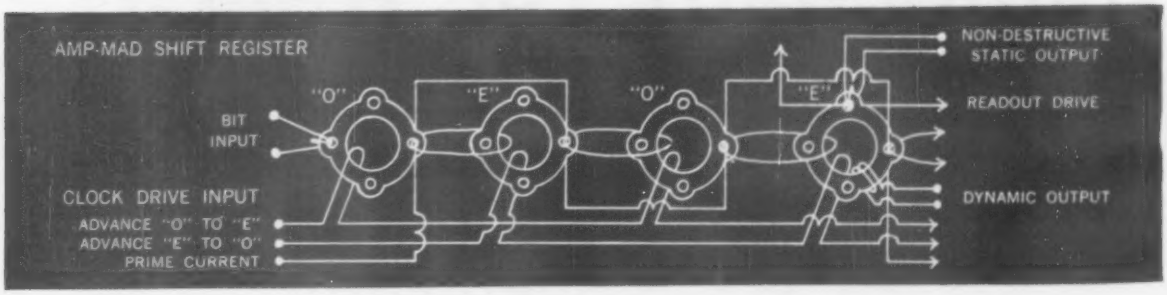

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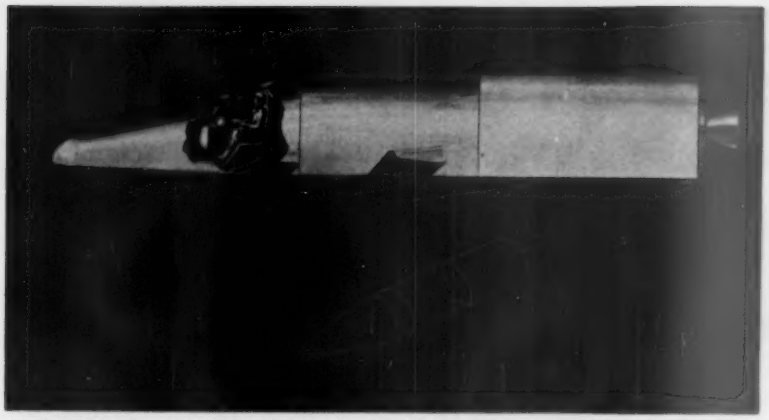

MANEUVERABLE SPACE VEHICLE is shown in this General Electric artist's conception. The semi-ballistic glide vehicle is divided into three sections: a piloted re-entry vehicle, a cargo midsection, and a jettisonable space propulsion and guidance section. Note trim tabs for aerodynamic control during re-entry and in the atmosphere. About 80% of the rocket propulsion section would be occupied by fuel for space maneuvering. The vehicle would be designed to change its orbital plane by as much as 30 deg.

Control Systems for Maneuverable Space Vehicles Are Investigated

Los Angeles—Aerodynamic methods of maneuvering during re-entry of a space vehicle add less weight than rocket maneuvering systems if payloads are heavy or the amount of maneuvering required is large, L. W. Warzecha of General Electric Co. reported to the summer meeting of the Institute of Aeronautical Sciences, here.

For small corrections, Warzecha found little to choose between the two techniques. He said that simple rendezvous missions dealing with a few unforeseen factors can be carried out at an early date.

The earliest and most important mission involving a requirement for maneuverability are these:

- **Satellite inspection.**
- **Retrieval and rescue.**
- **Ferry.**
- **Space search.**
- **Reconnaissance and patrol.**
- **Satellite kill.**

Warzecha said, "these missions are all similar in that they require rendezvous maneuvers, will probably be initiated at near-orbital velocities, and will consist of a single rendezvous operation per flight. Because of the required characteristic velocity increments, these missions must be performed from coplanar trajectories or from angles of 10 deg. or less between trajectory planes. Velocity requirements of about 5,000 fps. (more than the initial velocity) will be common for single-rendezvous maneuvers."

Search, reconnaissance and patrol missions may call for the ability to make complete rendezvous, but a simple intercept without eliminating the relative velocity of the two vehicles may be adequate for some of them. Warzecha said it is quite likely that these missions will demand the ability to make large trajectory plane changes, possibly 45 deg. or more. He said it would be highly desirable to be able to make multiple maneuvers, perhaps 10 per flight or more. The velocity requirements for these missions may be as high as 200,000 fps. and the minimum is set at about 5,000 fps. Because of the high requirements, these missions must await important advances in propulsion technology.

Satellite kill missions can be carried out with a simple intercept trajectory. One maneuver operation per flight and small trajectory plane changes in the terminal stage should be an adequate capability.

Velocity Increments

Characteristic velocity increments for the kill mission will be less than 5,000 fpm., so it should be possible in the near future.

Warzecha's assumptions in his space maneuver studies included altitude of 200 naut. mi. for the orbital vehicle with the rendezvous vehicle initiating the operation from the apogee of a ballistic trajectory in the path of the orbital vehicle. The initial relative range is 10 to 50 naut. mi. and the angle between the trajectory planes of the two vehicles is 30 deg. or less. He found that the initial relative range is not an important factor in any set of circumstances studied.

Recovery System To Slow Re-Entry Speed

Goodyear Aircraft Corp. has developed coated fabric balloons which inflate in 1/10 sec. for a high-altitude recovery system designed to control deceleration of re-entry vehicles (AW Jan. 25, p. 23). Called "Ballute," the system was developed for Air Research and Development Command's Wright Air Development Division. They are to be used to retard tumbling and control speed of instrumented nose cones, manned escape capsules and other orbital vehicles during re-entry through the earth's upper atmosphere. A parachute is ejected at lower altitudes to complete the recovery.

Specially modified Cree test missiles will evaluate the recovery system this summer. One shot will seek a velocity of Mach 2 at an altitude of 150,000 ft. and a second firing will be made to give Mach 3, 200,000 ft. altitude test conditions. During tests, the 9-ft. dia. balloon will be deployed and inflated behind the missile. When the missile is stabilized, the balloon will be reeled out until it reaches the flow region suitable for maximum drag.

Wind tunnel tests of 25% scale models have been conducted at National Aeronautics and Space Administration facilities at Lewis Research Center and Langley Research Center. Balloons reached altitudes of 155,000 ft. and speeds approaching Mach 3.5, simulating actual ejection, inflation and deployment conditions for the drag balloon, during which it proved to be stable in subsonic, transonic and supersonic flow, according to GAC.

Westinghouse Laboratory To Study Space Avionics

Westinghouse Electric's Air Arm Division will set up a new Astroelectronics Laboratory 40 mi. northwest of Los Angeles in the Conego Valley to specialize in missile and space vehicle avionics, with occupancy of temporary quarters taking place this month and construction of a new facility scheduled for completion in March, 1961.

Converter's Output Is 2½ Million Bits per Second

Analog-to-digital converter for reducing missile and space vehicle data, with an output speed of 2½ million bits per second, has been developed by Raytheon. Company says converter is 50 times faster than any comparable unit on the market and that output speed can be increased to 10 million bits per second. Conversion is accurate to within one half per cent of full scale.

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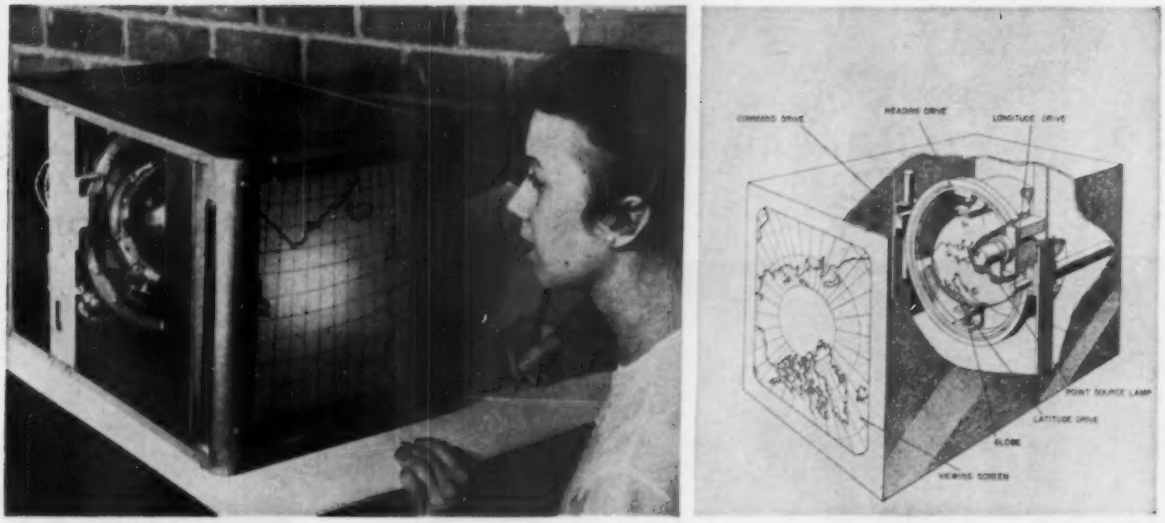


COCKPIT display for high-speed, long-range aircraft or manned satellites, uses flat screen display produced by internal illumination of small transparent cartographic sphere. Sphere, continuously positioned by external navigation computer, shows vehicle latitude, longitude and heading. Prototype model, made by Melpar, is shown left with cutaway drawing of device shown right.

Moving Globe Displays Pilot Position

By Philip J. Klass

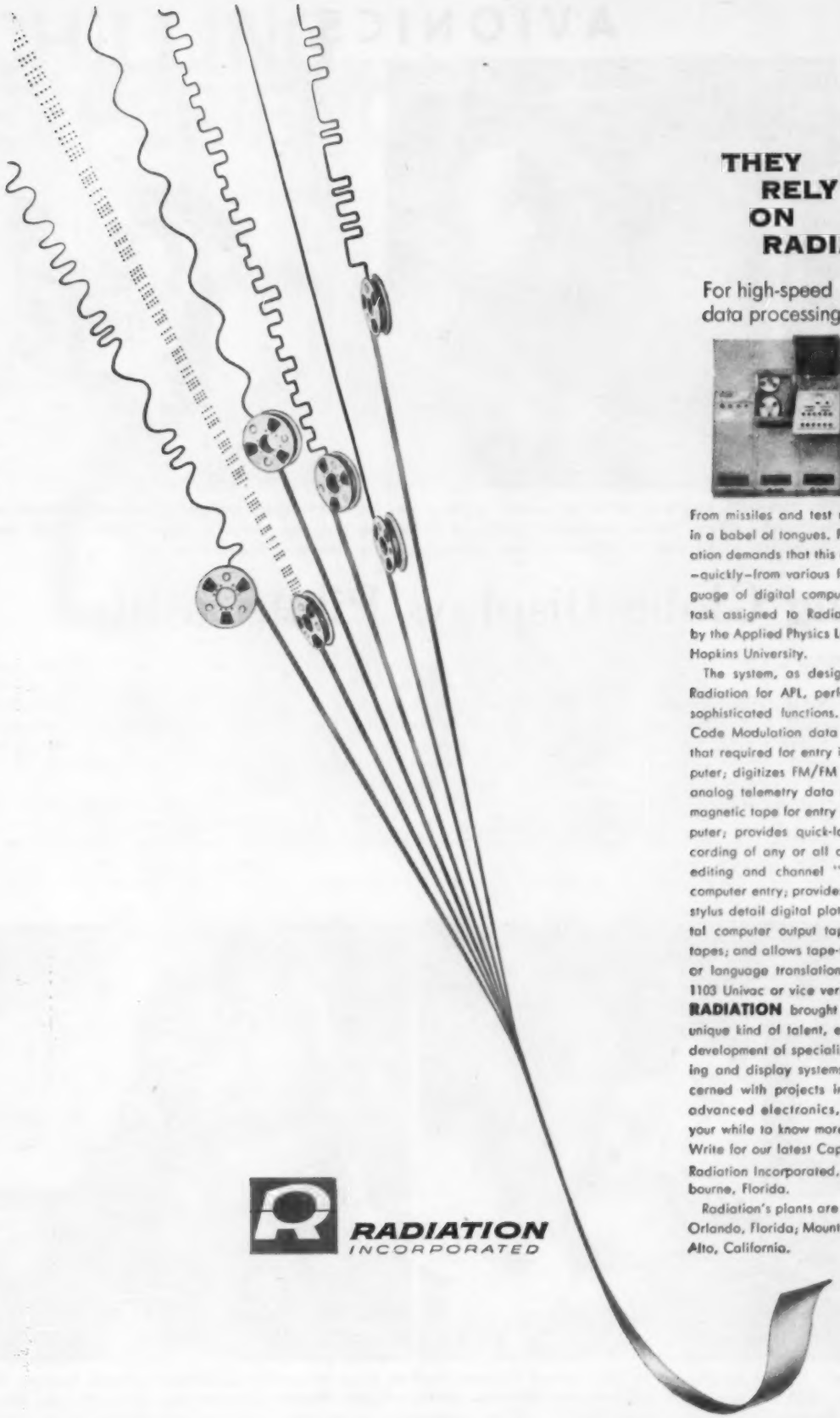
Washington—Novel cockpit displays for high-speed aircraft, particularly useful for those operating in polar regions, as well as for manned satellites or space vehicles, have been developed by Melpar and by International Business Machines Corp.

The devices developed by the two firms display vehicle position in true spherical coordinates on a small screen, projected from a small transparent cartographic globe, or hemisphere, which is continuously positioned by signals from an external navigation computer. The transparent globe is supported on a series of gyro-like gimbals which enable the display to show vehicle heading as well as its latitude and longitude. As adapted to space vehicles, the sphere or hemisphere could contain a stellar map of stars and planets.

Melpar has constructed a fully operational prototype with a 10 in. square screen which weighs 25 lb. including servo amplifiers. With transitorized amplifiers, and a slightly smaller screen, the over-all weight could be cut in half, according to project engineer Milton Goldin.

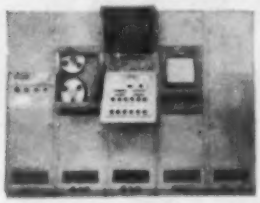
IBM has not yet constructed a complete operating model, putting its major effort into devising techniques for fabricating the small glass globe to the required precision and into projection

SIMILAR approach is being investigated by International Business Machines Corp. for possible application to North American B-70 Mach 3 bomber. IBM uses hemisphere and an optical protection system, a slightly different technique from that of Melpar. Closeup of hemisphere is shown right.



THEY RELY ON RADIATION

For high-speed data processing systems



From missiles and test ranges come data in a babel of tongues. Performance evaluation demands that this data be converted —quickly—from various formats to the language of digital computers. This was the task assigned to Radiation Incorporated by the Applied Physics Laboratory at Johns Hopkins University.

The system, as designed and built by Radiation for APL, performs a number of sophisticated functions. It converts Pulse Code Modulation data from raw form to that required for entry into a digital computer; digitizes FM/FM and PAM/FM/FM analog telemetry data and records it on magnetic tape for entry into a digital computer; provides quick-look multistylus recording of any or all channels for visual editing and channel "stripping" before computer entry; provides high-speed multistylus detail digital plots from either digital computer output tapes or the source tapes; and allows tape-to-tape conversion or language translation of IBM tapes to 1103 Univac or vice versa.

RADIATION brought to this project a unique kind of talent, experienced in the development of specialized data processing and display systems. If you are concerned with projects in similar fields of advanced electronics, it may be worth your while to know more about Radiation. Write for our latest Capabilities Report to Radiation Incorporated, Dept. AW-7, Melbourne, Florida.

Radiation's plants are at Melbourne and Orlando, Florida; Mountain View and Palo Alto, California.

RADIATION
INCORPORATED

optics, according to the company's Fred Longwell. Development started about a year ago as part of IBM's contract to develop the bomb-navigation system for the North American B-70 Mach 3 bomber, but since the cutback in this program, the company has carried on the globe display work with its own funds.

Melpar's spherical display development program, financed entirely with company funds, was launched about 2½ years ago, according to Goldin.

Although IBM and Melpar are aiming for similar devices, their design approaches are somewhat different. IBM employs a hemisphere, rather than a sphere, and an optical projection system. Melpar has selected the gnomonic approach, requiring no optics, which employs a small point-source lamp precisely located in the center of the sphere to produce an image on the external screen.

Scale Factor

By merely shifting the screen closer or farther away from the transparent globe it is possible to change the magnification, or scale factor, of the Melpar unit over a wide range. Prototype model can provide the 1:2,000,000 scale of jet navigation (J-N) aeronautical charts or the 1:5,000,000 scale of global navigation charts (GNC).

In the Melpar prototype, the 10 x 10 in. screen provides an area roughly 8 in. in diameter which has acceptable definition of the cartographic image. Because the image is being projected from a spherical surface to a flat screen, there is inherent distortion of distances as one moves out from the center of the screen—which point corresponds to the vehicle's present position. However, there is no angular distortion.

For a scale factor such that the screen is displaying in an area roughly 2,500 mi. in radius, there will be no appreciable distance distortion for a radius equivalent to about 600 mi. from the center of the screen.

A plastic overlay can be placed directly in front of the screen so the pilot or navigator can plot his desired track or targets in grease pencil.

Display Detail

The feasibility of the spherical projection display concept hinged on the question of whether a small glass globe could be fabricated with the required cartographic detail and precision. Melpar set as its goal the achievement of the same amount of detail which is contained on existing J-N (jet navigation) series of aeronautical charts, which have a scale of 1:2,000,000. In terms of the 5 in. diameter glass sphere which Melpar uses, this amounts to a reduction of 1:60,000,000.

This objective has been achieved both by Melpar and by the USAF's

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Designed and built by the Columbus Division of North American Aviation, the A3J has a versatility unmatched by any other Mach 2 airplane in the skies today. It is equipped to handle a variety of nuclear or conventional weapons for either limited or all-out nuclear war. It has the speed and maneuverability to fly single-plane attack missions without fighter escort.

The Vigilante can fly through the stratosphere faster than the earth turns beneath it; yet can throttle down to comfortable landing speeds for carrier decks—or small fields ashore. It is also notable for prompt response characteristics that make it ideally suited for low-level missions over irregular terrain. Its speed and maneuverability plus the most advanced fire control systems known make it a single airplane with an outstanding dual capability—high-performance attack or long-range interception.

The A3J Vigilante truly is a significant addition to the U. S. arsenal dedicated to preserving world peace.

THE COLUMBUS DIVISION OF NORTH AMERICAN AVIATION, INC.

Columbus, Ohio

Aeronautical Chart and Information Center at St. Louis, Mo., (which prepares aeronautical charts), each using different processes, according to Goldin.

The Air Force facility itself has developed two techniques for making the cartographic spheres. In one, production globes made of optical quality glass are coated with a photo-sensitive emulsion, then exposed to a master globe using a point source lamp. Photo developing processes are then employed to fix the image on the globes.

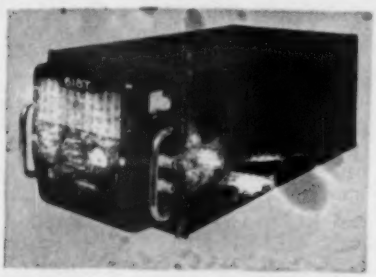
A more recent USAF technique employs flat sheets of plastic about 0.05 in. thick upon which the cartographic image is printed by photo processes, after which the plastic sheet is heated and blown into a spherical shape. The cartographic image is suitably distorted when printed on the flat sheet so that it will compensate for distortion of the sheet that takes place during the blowing process.

The cartographic spheres can be produced with black-and-white or color images, depending upon the operational requirements.

Melpar's technique resembles the first of the Air Force techniques, except that the company uses a series of photo-optical mosaics to produce the original master globe. After that the photo processes for making production units are identical.

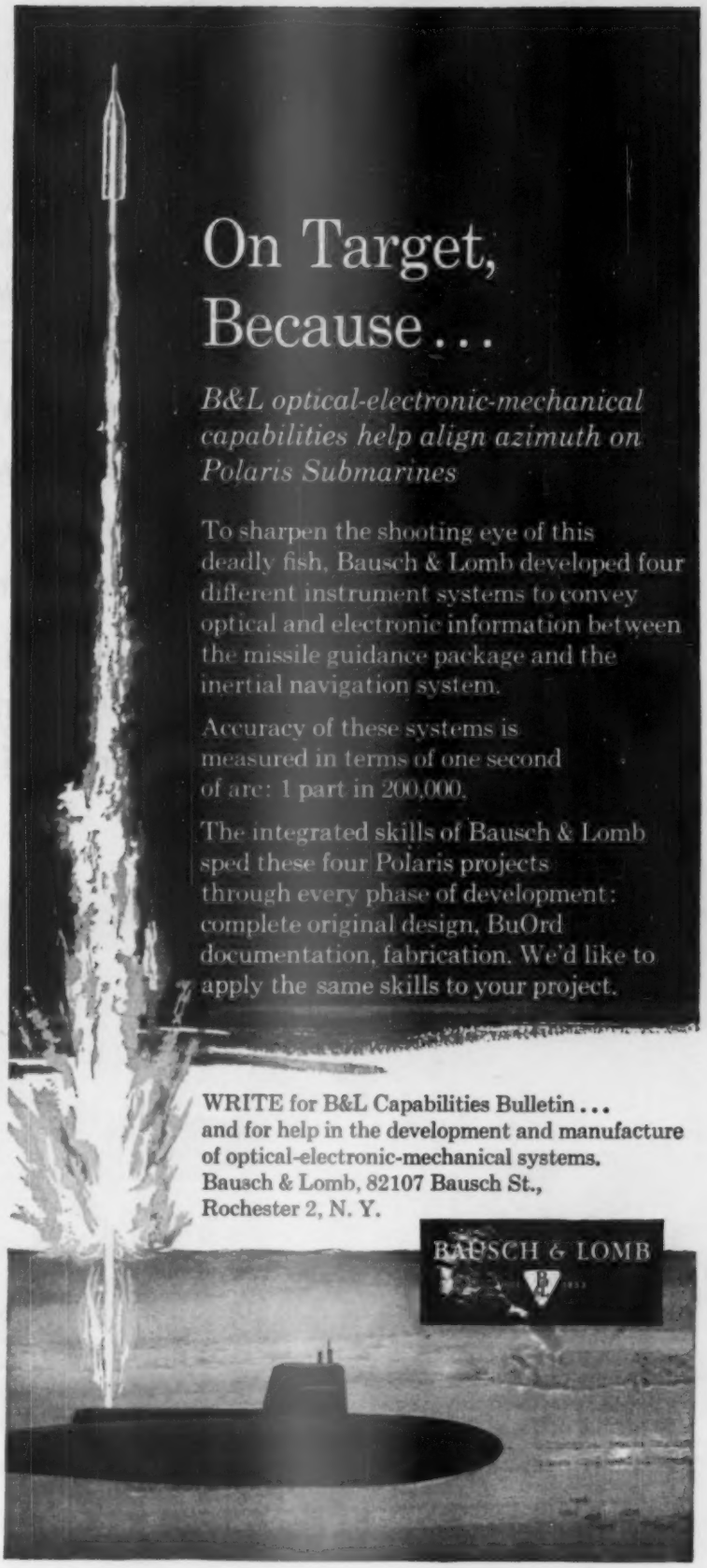
Because chart making is the St. Louis facility's main activity, Melpar probably would prefer to obtain the globes from the Air Force chart center rather than produce the units themselves, Goldin indicates.

The USAF chart facility now is able to produce these globes with the same degree of precision and accuracy as standard aeronautical charts, Goldin says.



Collins Transceiver

New airborne single sideband high-frequency radio transceiver, which also provides conventional AM operation, offers 28,000 channels in the 2-30 mc. band in 1 kc. steps. New Collins Radio 618T transceiver, which delivers 400 watts peak envelope power on single sideband or 100 watt carrier on conventional AM, weighs 47 lb. and occupies a 1 ATR-size case. First units become available in August.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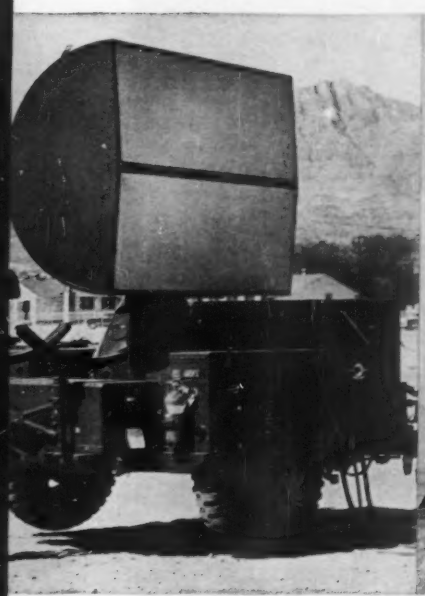
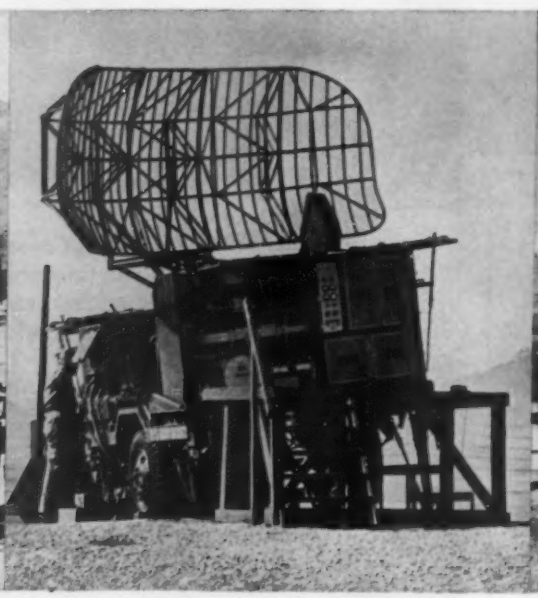


This continuous wave acquisition radar picks up targets down to tree-top levels.



The pulse acquisition radar detects high altitude targets and provides volume coverage in support of the continuous wave radar.

Tubular outriggers give the launcher good stability with maximum weight conservation.

the drawing board, get maximum design capabilities from all ground support materials. Consult with the one producer of all these materials. Whether it's carbon steel or special constructional alloy steels, Stainless Steel, electrical cable or wire rope... consult with

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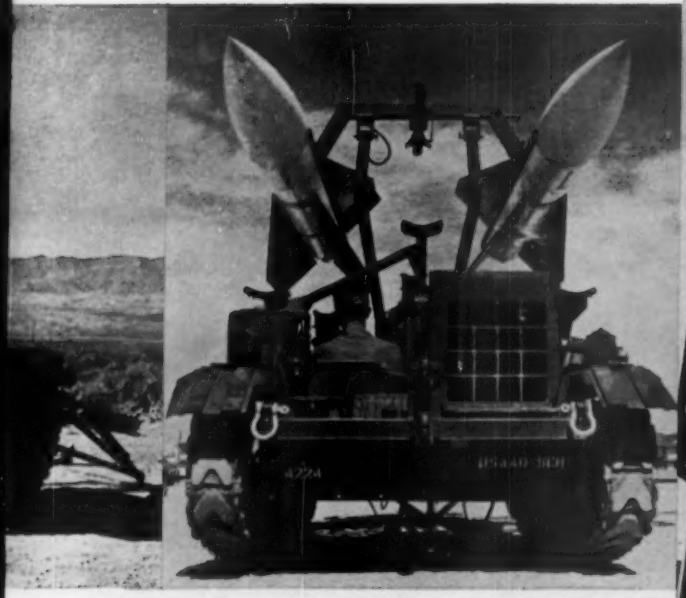
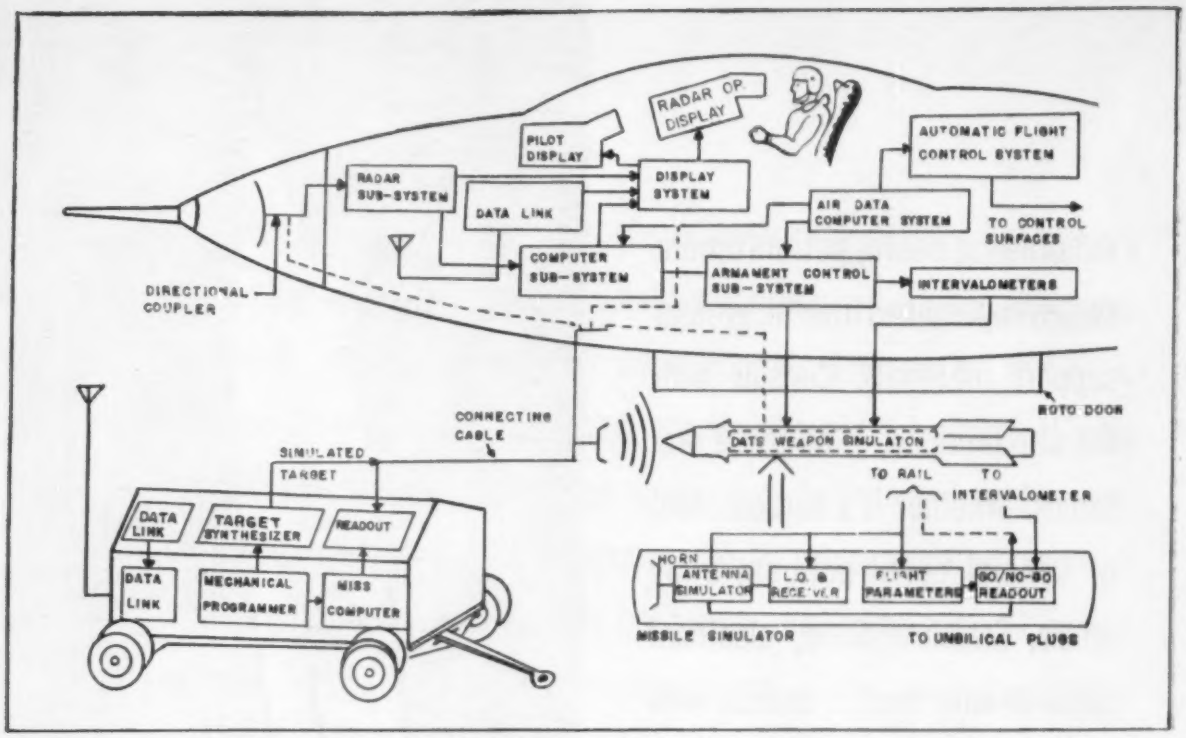


The Loader-transporter has an extremely low silhouette. It weighs only 5,250 pounds.

This mark tells you a product is made of modern, dependable Steel.



DYNAMIC Accuracy Test System (DATS) feeds simulated target into radar directional coupler of weapons control system which locks on and tracks "target" and prepares weapon simulator for firing. Miss computer in mobile checkout system calculates and displays azimuth and elevation errors of simulated firing after receipt of firing signal activated by the weapons control system computer.

Ground Unit Speeds Weapon Control Test

By Barry Miller

Camden, N. J.—Flight-line dynamic test equipment capable of slashing checkout time of airborne weapon control systems in Convair F-102 interceptors from 3¼ hr. to 15 min. are being manufactured here and will be delivered to the Air Force in October.

In nine months of initial field testing at Eglin and Tyndall Air Force Bases in Florida, the equipment—known as DATS (Dynamic Accuracy Test System)—tripled the combat readiness availability of interceptors, according to spokesmen for RCA's Defense Electronics Products Division. The company is turning out 120 DATS units under a $6 million engineering and production contract from Warner Robbins Air Materiel Area, Robbins AFB, Ga.

Proposals for additional DATS units to be used with the weapon systems of McDonnell F-101 and Convair F-106 interceptors, among others, are currently being evaluated by the contracting agencies.

The DATS units in production here are designed to evaluate the over-all performance of the airborne weapon control system for the F-102. Other DATS units, RCA says, can be adapted to verify operational readiness of a wide variety of complex electronic equipments.

In the F-102 application, DATS employs a series of six synthesized attack courses to obtain a quick, reliable check of system performance under dynamic operating conditions. The attack courses, comprising one rocket and two missile runs in either one of

ENGINEERING model of Dynamic Accuracy Test System (DATS) to be delivered to the Air Force is shown undergoing evaluation. Test system is said to increase combat readiness of interceptors by quick, dynamic checkout of airborne weapons control systems.

two quadrants, are typical of actual interceptor operating conditions and were selected, the company explains, to exercise as much of the weapon control system as possible.

Principal features of this equipment, RCA says, are:

- **Rapid preflight checkout** to ensure that only aircraft with excellent probability of mission success become airborne.
- **Presentation of quantitative** information on the aircraft's mission success probability.
- **Light weight,** hand towable and air transportable equipment, housed in a mobile console.
- **Operation** and maintenance by moderately skilled personnel.
- **Self-checking** capacity.

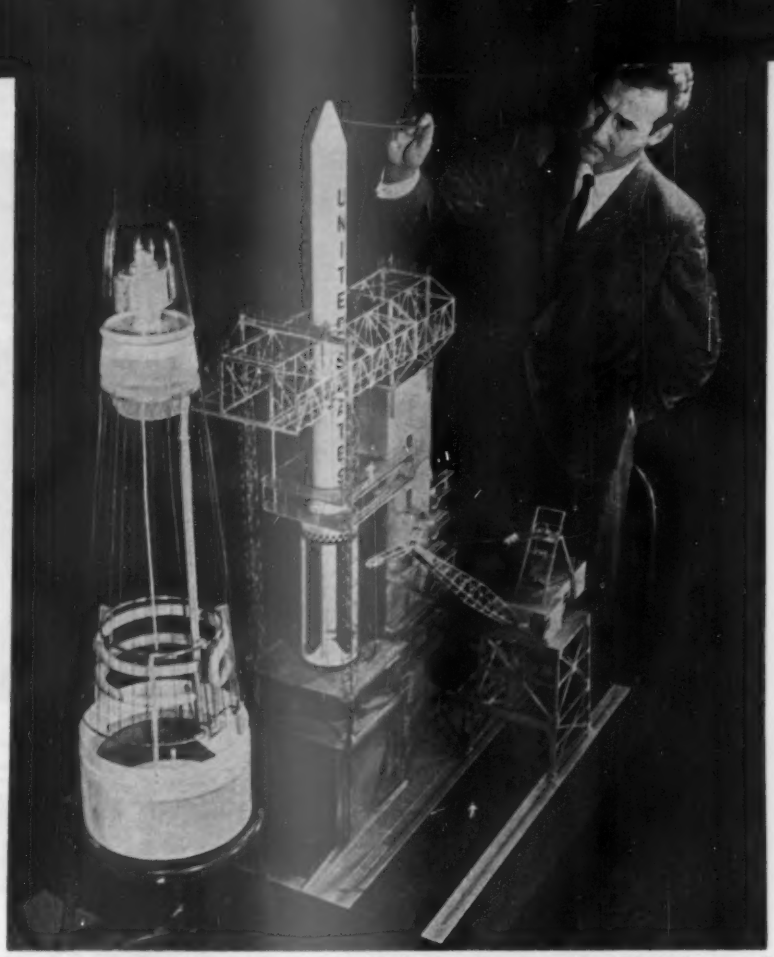
DATS consists of a mechanical programmer which generates the attack missions, a target synthesizer which provides a synthetic target on direction of the programmer and transmits it through a coaxial cable to the directional coupler in the plane's weapon control system, and a miss computer which calculates the armament miss distance in azimuth and elevation under simulated weapon firing, and then presents this information on separate direct reading meters at the face of the console. Plugs and fixtures for a data link tester as a section of DATS are also included. The equipment is operated by one man, assisted by another located at the display in the cockpit.

Checkout Procedure

For operation, the DATS console can be tractor-towed to the flight line and subsequently hand-towed between adjacent aircraft. First step in checkout procedure is connection of DATS to primary power, obtained from the weapon system control itself, and attaching signal cable in the aircraft nose wheel well. During weapon control system warmup, a weapon simulator, carried in a rack on the mobile DATS cart, is loaded on a missile launching rail of the aircraft. The DATS target horn is placed in front of the simulator, which is then retracted into the aircraft's armament bay. The maintenance man then puts DATS through a series of self-test routines.

The weapon control system is activated and a synthetic target signal generated by DATS is observed on the radar screen in the cockpit. Lock-on sensitivity and power output are read at the DATS console and recorded.

The radar operator starts a DATS attack run by locating and locking on to the moving DATS target. The control system then automatically tracks the synthetic target as it would a real target. The radar antenna tracking loop is closed through an r.f. link around the DATS target to provide angular



North American's SNAP II (Systems for Nuclear Auxiliary Power) model in foreground would be installed in nose of space vehicle as shown above. SNAP II reactor (AW Dec. 7, 1959, p. 90) has been checked at full power and power conversion unit, developed by Thompson Ramo Wooldridge, also is operative. Reactor delivers 50,000 watts.

SNAP II Reactor Tested at Full Power

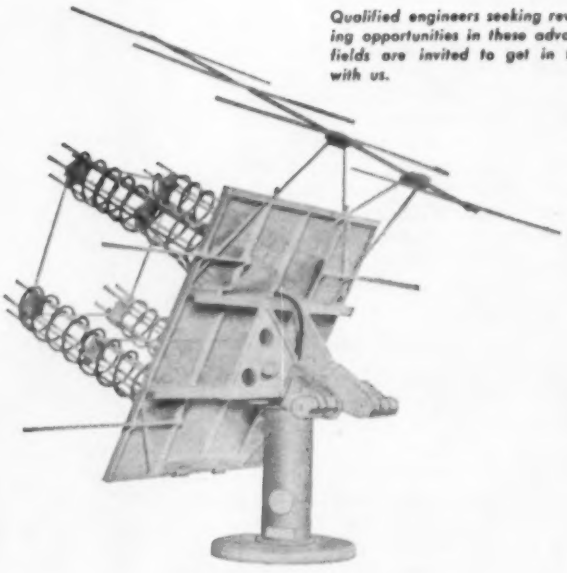
Reactor core vessel is checked prior to start-up; core contains 61 cylindrical fuel elements. Energy is delivered to liquid sodium heat transfer fluid, entering the core at 1,000F and maintained at 1,200F. North American says SNAP II can be scaled to 300 kw.

antenna systems capability

The directional antenna and its mount have become symbols of the missile age and its advancing technology. Representing a challenging complex of mechanical and electronic problems, they demand the utmost in ingenuity and precision for their solution.

Reeves has over ten years of diversified experience in the co-ordinated design and development of two and three axis antenna mounts and their related servo, radar and computer instrumentation. Currently actively engaged in the DISCOVERER and PROJECT MERCURY PROGRAMS, Reeves has produced antenna systems for the TERRIER and MATADOR programs, as well as a wide range of mounts for other missile tracking and guidance applications.

If your projects involve development of advanced antenna pedestal equipment and systems for search, tracking, guidance or control, it will be worth your while to contact Reeves.



Qualified engineers seeking rewarding opportunities in these advanced fields are invited to get in touch with us.

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REEVES INSTRUMENT CORPORATION • *A Subsidiary of Dynamics Corporation of America* • Roosevelt Field, Garden City, New York

position and rate information. This is processed by the computer subsystem which provides steering and timing information to other subsystems.

Subsequently, the armament subsystem prepares the DATS weapon simulator by tuning it to the correct radar homing frequency, positioning the range gate over the target and setting aerodynamic parameters for proper flight in the DATS simulated environmental conditions.

As firing time approaches, the armament doors open, and the weapon simulator is extended on receipt of the computer-activated firing signal in DATS. Azimuth and elevation miss are computed and displayed on the DATS meters. A direct go, no-go readout at the weapon simulator indicates if weapon was properly prepared.

Anticipated misses are automatically evaluated, RCA indicates, by measuring the steering errors and the time at which the weapon simulator is fired.

This same operating procedure can be repeated for other simulated attacks and other launching rails. Total time for the complete DATS check is 15 min., RCA says, which includes connect, set up, warmup, test and disconnect times. A step-by-step manual checkout of the system requires 3½ hr.

If the armament miss distance is within allowable limits, the weapon is regarded as operational. Should the miss indications fail to fall within these limits, however, DATS can aid in isolating the fault during troubleshooting, the company says. Because DATS is a straight-through tester, it is said to help locate many types of system faults and can be used in static testing of the control system.

Incorporated in DATS is a self-test capability consisting of confidence checks and alignment tests. Confidence checks verify correct operating status of DATS before use and the alignment tests are run periodically. As indicated, self-testing is performed during weapon system warmup time.

In one typical self-test routine—one employed for the miss distance computer—a fixed error is inserted in the azimuth and elevation error channels and a fixed firing delay in the time of firing comparator. After computer processing, the results are read at the error indicating meters and compared with known values to see if the computer is operating properly. The self-test equipment is referenced to passive components such as a quartz delay line to ensure maximum possible reliability.

A mechanical programmer was designed into DATS to gain accuracy and repeatability, according to RCA. Adaptations of DATS for systems other than the F-102 weapon control system would rise in complexity from a simple cam change for a similar type of weapon system. Predicted target range accuracy of the miss computer is said to be within 10 yd. plus or minus ½ of 1%.

Flight Monitor Gives Pilot Audio Warning

Automatic monitoring and audible warning of 12 potentially hazardous flight conditions is provided by a recently-developed airborne recorder to supplement warning lights and increase pilot reaction time. Developed by Nortronics Division of Northrop Corp., the voice warning system can monitor flight instruments, engine instruments and aircraft configuration, plus preflight and prelanding check lists, etc.

The Nortronics voice warning system is set to operate upon activation by sensors of aircraft condition such as exhaust gas temperature, low fuel pressure, landing gear or flap position, alternator or generator condition, or any combination of predictable flight hazards. A prerecorded message is fed into the pilots headset or through a loudspeaker system to warn the pilot of a possibly dangerous condition and instruct him of the remedial action.

Until the condition is corrected, or

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Not just the sea, but the surface and the air as well, comprise the theatre of ASW. And in all these areas, Sperry is making advanced contributions: submarine sonar detection gear . . . submarine fire control systems . . . submarine depth and maneuvering controls . . . countermeasures and counter-countermeasures . . . sophisticated navigational computers for helicopters, capable of programming a systematically precise sub search . . . automatic flight controls for the helicopter to permit it to do its job despite the vagaries of weather or mission complexity . . . for surface ships, precision torpedo fire control and hydrofoil stabilization and control systems.

Most of today's ASW programs utilize sound radiation techniques. But being explored are myriad "unsound" techniques of sea-hunting, vast new frontier for scientist and engineer . . . investigations in the electro-magnetic spectrum . . . development of advanced transducers, data processors, and means of displaying data that is gathered.

These anti-submarine warfare programs, ranging through the three dimensions of our environment, typify the *integrated* capability of the Sperry organization today. General offices, Great Neck, N. Y.

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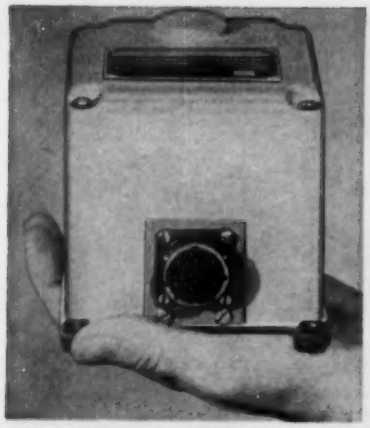

OUTLET above connects with 12 channels; space is reserved for 10 more.

until the pilot manually deactivates the system, messages will be repeated. Should a condition of higher priority occur while a message is being transmitted, the device has a logic circuit to interrupt the lower priority message.

The voice warning system has been evaluated in two Convair B-58 Hustlers by crews of the Joint Test Task Force at Carswell AFB Tex. with the result that a recommendation was sent forward requesting that the system be incorporated in all of the Mach 2 bombers scheduled for the Strategic Air Command inventory. Indications are that it is of particular value in single-pilot aircraft where the pilot may necessarily concentrate on one set of flight conditions to the exclusion of other details.

A typical example would be an actual weather instrument approach during which a pilot would find it necessary to devote his attention almost exclusively to the flight instruments and be unable as thoroughly to monitor important engine instruments.

Messages up to 15 sec. in length may be prerecorded and can be used to announce:

- **Periodic pilot alertness checks.**
- **Cockpit procedure training sequences.**
- **Messages to crew members** and passengers.
- **Flight test programs.**

The unit uses 28 v.d.c. current and draws 2 amp. when in operation. There is no current drain while in standby. It weighs 4.5 lb. and measures 4.4 x 4.2 x 4.9 in.

A test and recording module is available to record messages, check recordings through earphones or speaker, and test operation of logic circuit. Complete test of the voice warning circuit is made with the test and recording module without removing the unit from the aircraft. All that is required is to replace the playback cable from the system with a cable from the test module.

At 10 miles per minute "almost" reliable won't do

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SYLVANIA GOLD BRAND TUBES are built to take the demanding operation required in modern jet aircraft and still perform reliably. The popular Sylvania GB-5654, as an example, proves its dependability daily as an amplifier in aircraft communications receivers.

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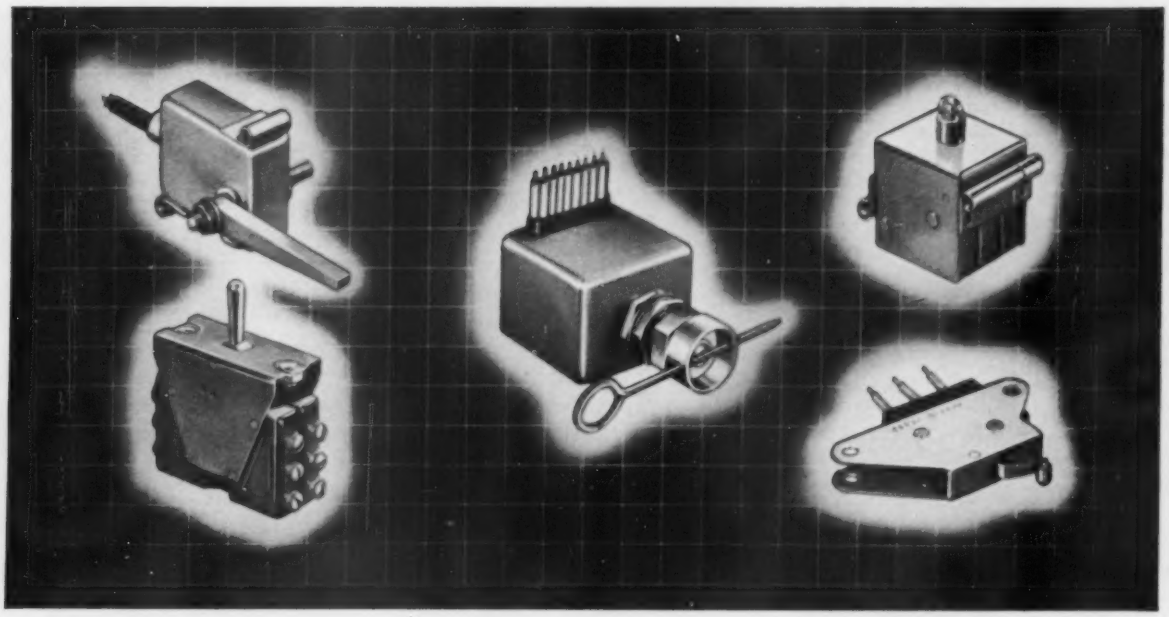

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Twenty representative KLIXON precision switch packages are shown in photographs and dimensional drawings in a recently published technical bulletin. Write for your copy today.

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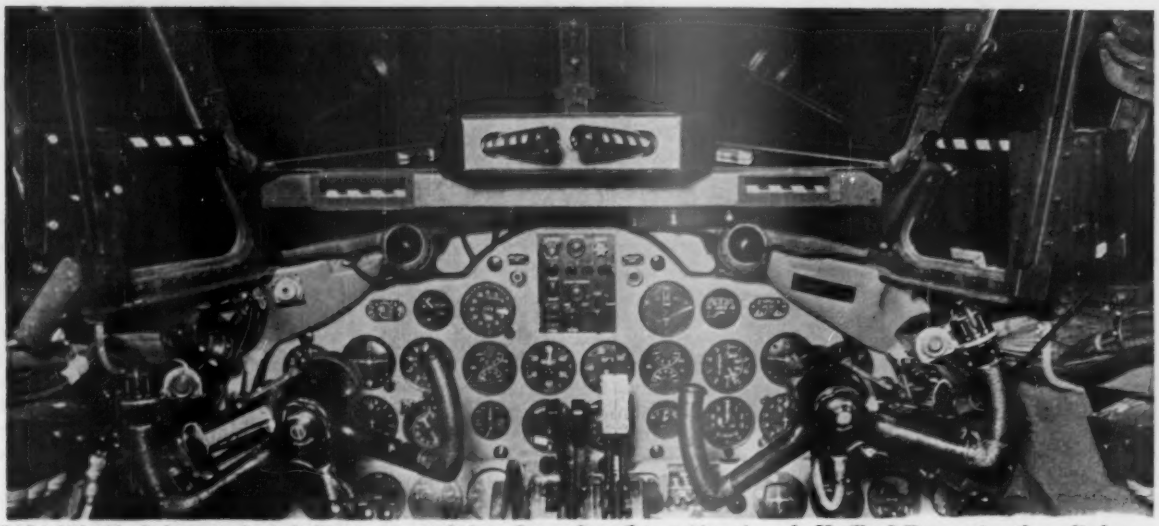


PARA-VISUAL flight attitude indicator is mounted for pilot and copilot positions in a de Havilland Dove, using three displays.

Pilot Aid Designed for Automatic Landing

By John Tunstall

London—Newly developed cockpit visual indicator may substantially advance the use of automatic flareout landings in the de Havilland DH-121 jet transport, along with lowering of flight minimums.

New concept, called Para-Visual Directors (PVD), was developed by Smiths Aircraft Instruments, Ltd.

It feeds flight attitude information to the pilot when he is looking outside the cockpit—black and white stripes move directionally along the axes of suitably oriented display tubes, in accordance with computed bank and pitch error signals supplied by a conventional flight director.

To null the signals, the pilot moves the control column in the direction of the moving pattern. The displays are so positioned with respect to the pilot's head that although his field of vision is outside the cockpit, the displays are still visible within his extrafoveal (retinal) perception. It means that the pilot can see the flight demand signals during transition when scanning for runway lights in a 90 deg. arc ahead.

Pilot Opinion

Since the first announcement of the PVD display technique at the International Air Transport Assn. conference at Lucerne this year, Smiths Aviation Division has been conducting extensive flight demonstrations for pilots, airline officials and certification authorities. Pilot opinion so far, A.M.A. Majendie, director of operational requirements, said, has been favorable.

Another advantage of the display, used as normal flight instruments, which have brought favorable pilot comment is the fact that the moving character of the display appears to offer the pilot a vernier control of the aircraft's attitude. This encourages within the first few moments of flight a superior flight reaction which is both relaxed and instantaneous.

Basic design of the display units has been frozen and production of the unit and a number of coupling units to suit various flight directors has been finalized. By the time units are available next year, Smiths expect to have established sufficient reliability data.

The basic design has been optimized for the DH-121 which will enter service with a Smiths duplex autopilot and with the PVD displays as a third independent control channel.

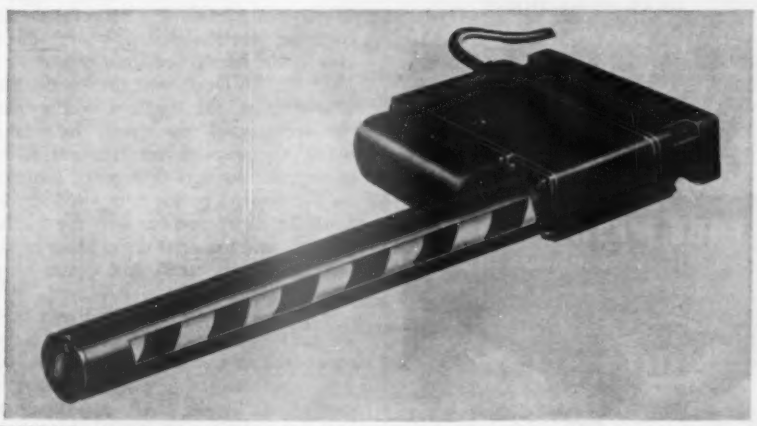
The PVD display units can be coupled to any flight system and used:

- **In azimuth,** to hold a heading; to intercept and maintain the center of an ILS beam.
- **In pitch,** to hold the aircraft about a pitch datum and automatically to couple onto and maintain the center of an ILS glide path. It also can provide VOR coupling in azimuth and height.

VTOL Uses

The system is being adapted for VTOL aircraft and for helicopters. In the latter, one display is allocated to rotor rpm.

In conjunction with the British blind landing system under development by the Blind Landing Experimental Unit of the Royal Aircraft Establishment, the displays have been



DISPLAY unit utilizes "barber pole" cylinder viewed through a slot; stripes indicate direction.

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used to provide all the appropriate demand signals for manual flight or as monitors for the automatic flight control, from approach to touchdown.

In conditions of zero visibility, flight tests have shown, Majendie revealed, that the close instrument control possible with the displays, in conjunction with freedom of the pilot to scan ahead and integrate the flight information with the ground fog light system, results in smooth transitions and touchdowns.

The moving color pattern display is achieved by black and white helical bands painted onto a cylinder which is rotated within the display tube. When viewed through a longitudinal slot in the tube, the helices provide a succession of black and white bands moving along the slot. Direction of rotation is arranged so that the pattern moves in the same direction as the movement of the control column needed to comply with the computed demand signal. Speed of movement of the pattern is proportional to the error signal.

The azimuth and pitch display units are placed perpendicular to each other, with the azimuth unit athwartships and in front of the pilot just below eye level. The pitch displays are aligned fore and aft on either side of the pilot's head and slightly forward. Both pitch displays are slaved together.

The pilot moves the column in the same direction as the display movement —so-called natural sense reaction—and the tentative explanation now put forward, based on fundamental studies in display techniques over several years, suggests that a pilot is instinctively exploiting the same stimuli in the air which are used in the preservation of postural balance on the ground.

If a man standing at rest sways forward, nearby objects appear to move backwards and the instinctive correction needed to restore balance, a backward correction, is in the same direction as the movement of the visual clues on either side. The same theory applies in the case of sideways movement—the restoring reaction is in the same direction as the background movement.

In the PVD system, the motivation is analogous, the displays synthesizing the background movement. In normal flight, the displays are arranged to be quiescent. But any divergence imposed on the displays by the computed signals from the flight director shift the display patterns and the pilot slaves them in the same direction, until quiescence is restored.

The condition that a pilot uses moving background information and movement in this way during transition was first demonstrated in physiological tests carried out by the RAE and the Institute of Aviation Medicine some years ago.

The tests revealed that although the pilot may be looking straight ahead with his fixative vision (and hence not within the cockpit), he is deriving attitude information with the extra-foveal regions of his vision from movement on either side of him which is outside his fixative vision.

In this case, the PVD displays synthesize the extra-foveal background movement with attitude demand signals and enable the pilot to scan the ground ahead while flying tightly coupled to the glide path.

Furthermore, Smith points out, the extra-foveal regions are very sensitive to moving stimuli but virtually oblivious to static objects. This condition consequently enhances the arresting properties of the display when a divergence occurs.

The quiescent nature of the display at all other times also avoids the fatigue caused by a moving display over long periods.

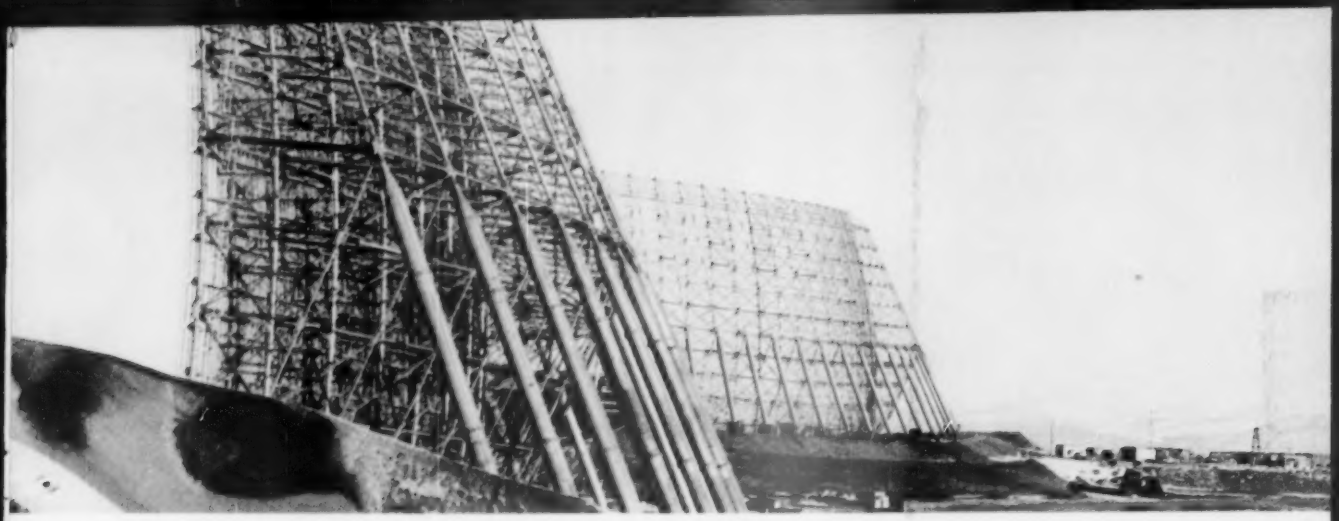
Complete freedom of head movement without losing sight of the display and of seat adjustment are considered to be among the important advantages of the PVD method.

NEW AVIONIC PRODUCTS

• **Static inverter** employs extruded aluminum heat sinks as structural members thereby permitting reduction in weight to 8.75 lb. Unit has no moving parts. It will deliver 750 watts at 120 v.a.c. for a 28 v.d.c. input. Efficiencies of 80% are achieved, according to the firm, Vap-Air Division, Vapor Heating Corp., 6420 West Howard St., Chicago 48, Ill.

• **Snychro tester** measures electrical zero and error, fundamental and total null synchro characteristics as described in MIL-S-20708A. All synchros may be measured at 1,000 per month rate by unskilled operators. Price is $4,500 and delivery is from stock, according to Theta Instrument Corp., 520 Victor St., Saddle Brook, N. J.

• **Voltmeter, Model 300-G,** with 1% accuracy over meter scale from one millivolt to 250 v. and 20 cps to 20 kc. is now available. Better than 2% accuracy can be expected up to 1,000 v. and in 10 cps. to 250 kc. band. Voltage range is covered in six decade ranges. Input impedance is 2 megohms shunted by 15 picofarads (25 on lowest scale). Tests indicate instrument can maintain specified accuracy without recalibration or tube replacement for several thousands of hours use, according to manufacturer, Ballantine Laboratories, Boonton, New Jersey.



Professional placement report
for Electronics Engineers

How the continuous need to improve the nation's space surveillance capabilities opens avenues for new engineering careers

The continuous need we are talking about at General Electric refers to the fact that future-generation missiles, satellites and deep space probes will require refined or entirely new detection techniques, including many that have not yet been conceived.

For example, it is anticipated that for every technical discipline now utilized in the detection field, at least one more must be found to apply within the next 10-year period.

With this in mind, General Electric is increasing its electronics engineering staff now working on advanced missile, satellite and deep-space-probe detection systems. Keeping pace with this expansion, the Company added a new building last year, and another will be ready for occupancy in a few months.

First clues to this trend were obvious in General Electric's well known "Golfball Study," published five years ago. This study compared the problem of missile detection to that of locating a golfball 200 miles away, using the most advanced techniques available in 1954. The problem no longer has such proportions, thanks to the creative imagination of dedicated General Electric engineering, scientific, and technical personnel responsible for designing and developing the unique surveillance sub-system of the Ballistic Missiles Early Warning System (BMEWS) which is receiving headline attention today.

Find out more about these creative and self-expressive opportunities now open to qualified personnel in one of the most vital technologies of the space age.

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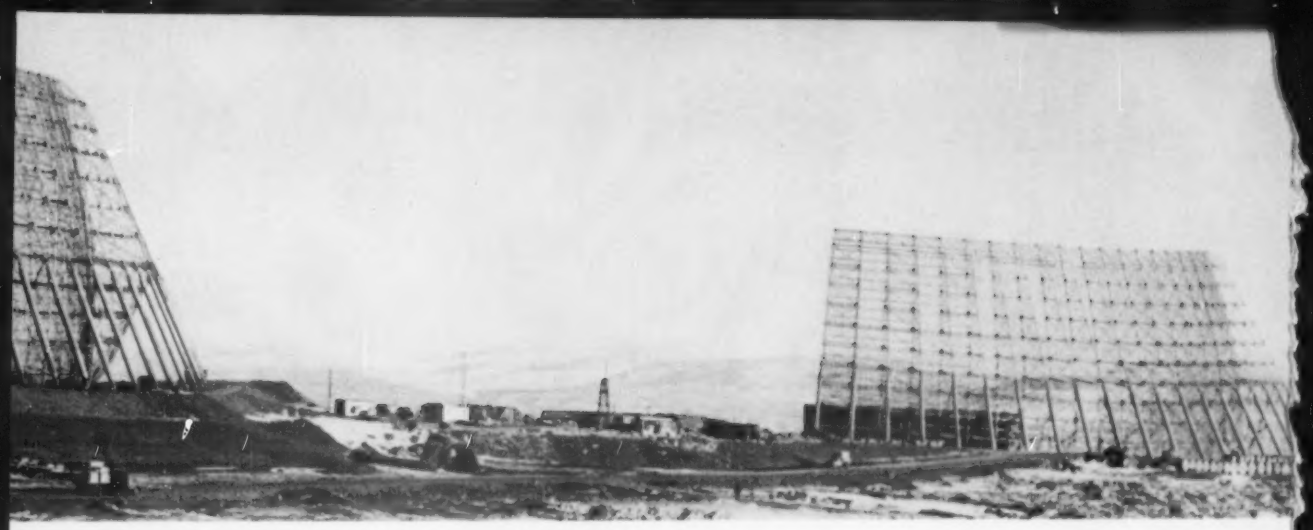

Immediate openings for qualified electronics engineers

RADAR EQUIPMENT SYSTEMS SPECIALISTS capable of conceiving and directing the design of long-range radar systems. Desirable experience includes 3 to 10 years in at least one of the following: radar systems design, antenna systems, RF components, transmitters, radar receiver systems or radar data processing systems. Salary structure is fully equal to the professional requirements of the job.

ADVANCED SYSTEMS ENGINEERS capable of defining future defense and space detection problems including deep space-probe tracking. Also the ability to conceive and establish the feasibility of optimum systems solutions to these problems—making use of the most advanced techniques and understandings. Also required is an ability to recognize the need for, and coordinate the development of, new techniques and the exploration of new phenomena. Experience requirements include a Bachelor degree plus a combination of advanced training and several years' experience in both the theoretical and practical aspects of detection systems engineering. A desire to work in the conceptual phase of systems design with the analytical ability required to evaluate and demonstrate the effectiveness of the proposed systems is essential.

FIELD OPERATIONS ENGINEERS for systems management teams to be deployed at complex radar systems installations of the BMEWS type. Systems-oriented Electronics Engineers are needed who have the ability to assume responsibility for installation, checkout, and integration of major radar systems. Background in high-powered Klystron transmitters, low-noise receivers and digital data processing equipment is desirable. A Bachelor degree is required.

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In addition to contributing amazing strength/weight ratio at critical points of the B-58, Rohr honeycomb panels stay cool and dampen sonic vibration at high speeds.

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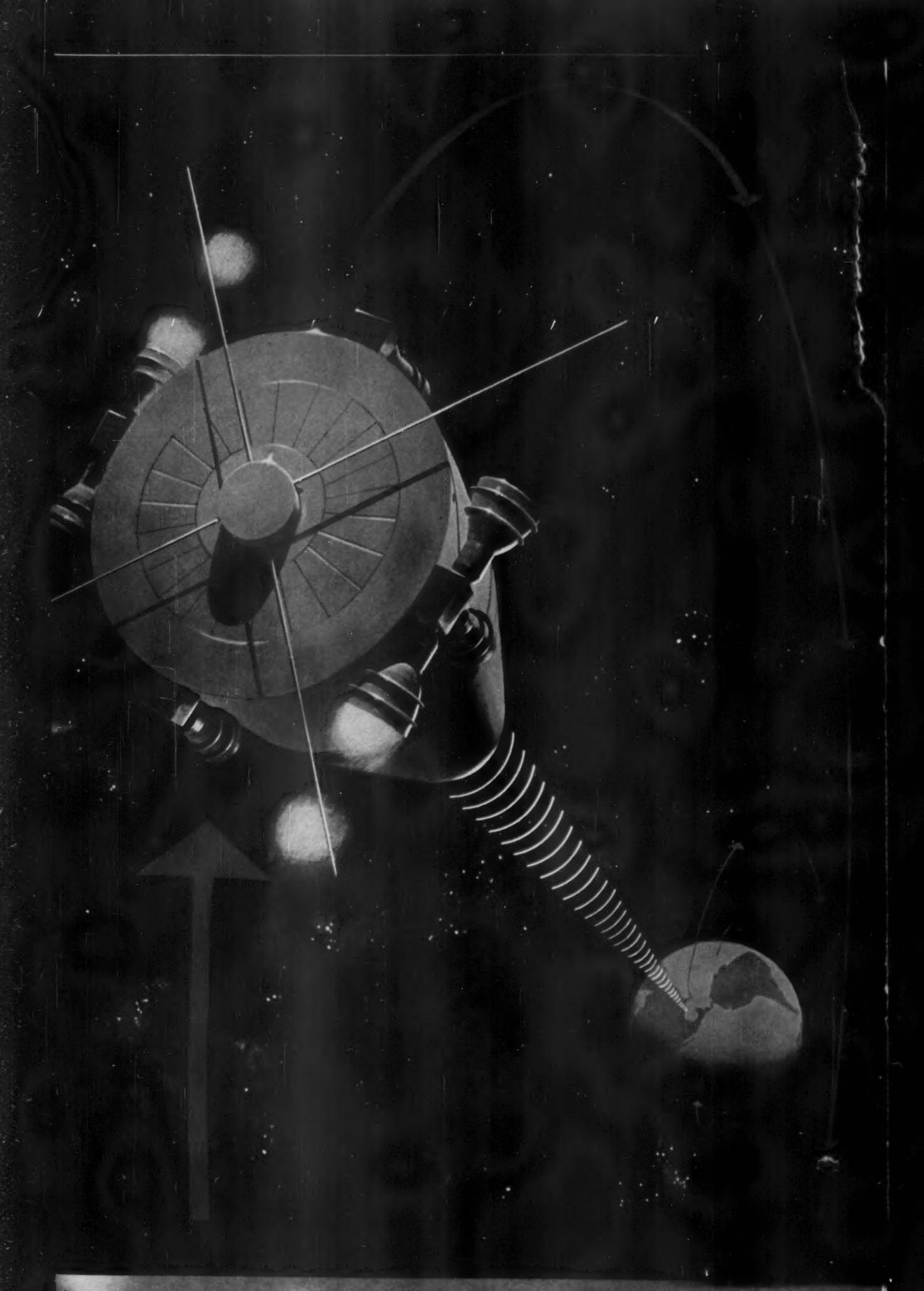

MARQUARDT PAT-C* SYSTEM MAKES POSSIBLE PRECISION SPACE CONTROL

New control gives 3500 to 1 modulation and .001 pound-seconds impulse

Orbit correction, station keeping and attitude control of a 24-hour surveillance satellite which must orbit in a fixed position 24,000 miles above a predetermined point on earth, is but one unique application of PAT-C—position, attitude, trajectory control system—a development of The Marquardt Corporation's Controls and Accessories Division.

The PAT System is a highly responsive jet reaction control which controls the flight path, the position and attitude of a space vehicle as a result of intelligence inputs from the vehicle guidance system or ground control. The system is capable of providing the necessary corrective action based on the simple position and velocity error signals or will respond to the demand of complex guidance computers in the system. The thrust level can be adjusted over a range of 3500 to one (or more in some cases) with the same set of rocket nozzles; proportional control of thrust from 0 to full thrust is possible. Impulse imparted to the vehicle can be controlled accurately over a wide range down to a few milli-seconds in duration—with a one lb. thrust nozzle as low as 0.001 pound-seconds. In the attitude control mode, the PAT system can maintain pointing accuracies not possible with other systems due to its low propellant consumption in limit cycle operation.

In a typical case, an accuracy of 0.1 seconds of arc can be held for 1000 hours with 40 lbs. of propellant.

Marquardt's fifteen years of research, development and production has resulted in state-of-art advancements in a wide range of electronic, electro-mechanical, pneumatic and hydraulic controls and accessories. For example, a pneumatic servo actuator is now available for 1600°F service—and severe nuclear radiation environments.

For additional information concerning the PAT-C System or other C & A capabilities, contact Dick Oblinger, Chief Applications Engineer-Controls and Accessories, The Marquardt Corporation.

Engineers and Scientists experienced in these or related fields will find it rewarding to discuss their career futures with Marquardt. Founded in 1944, Marquardt now has a staff of 5,000—two out of three are professional people. The company's growth is a parallel to the atmosphere of challenge and rewarding accomplishment that has existed since the firm's beginning.

Shown in photograph below—Marquardt engineers discuss a full scale mock-up of a complete self-contained PAT-C unit designed for application to space vehicles.

CONTROLS & ACCESSORIES DIVISION

THE Marquardt CORPORATION

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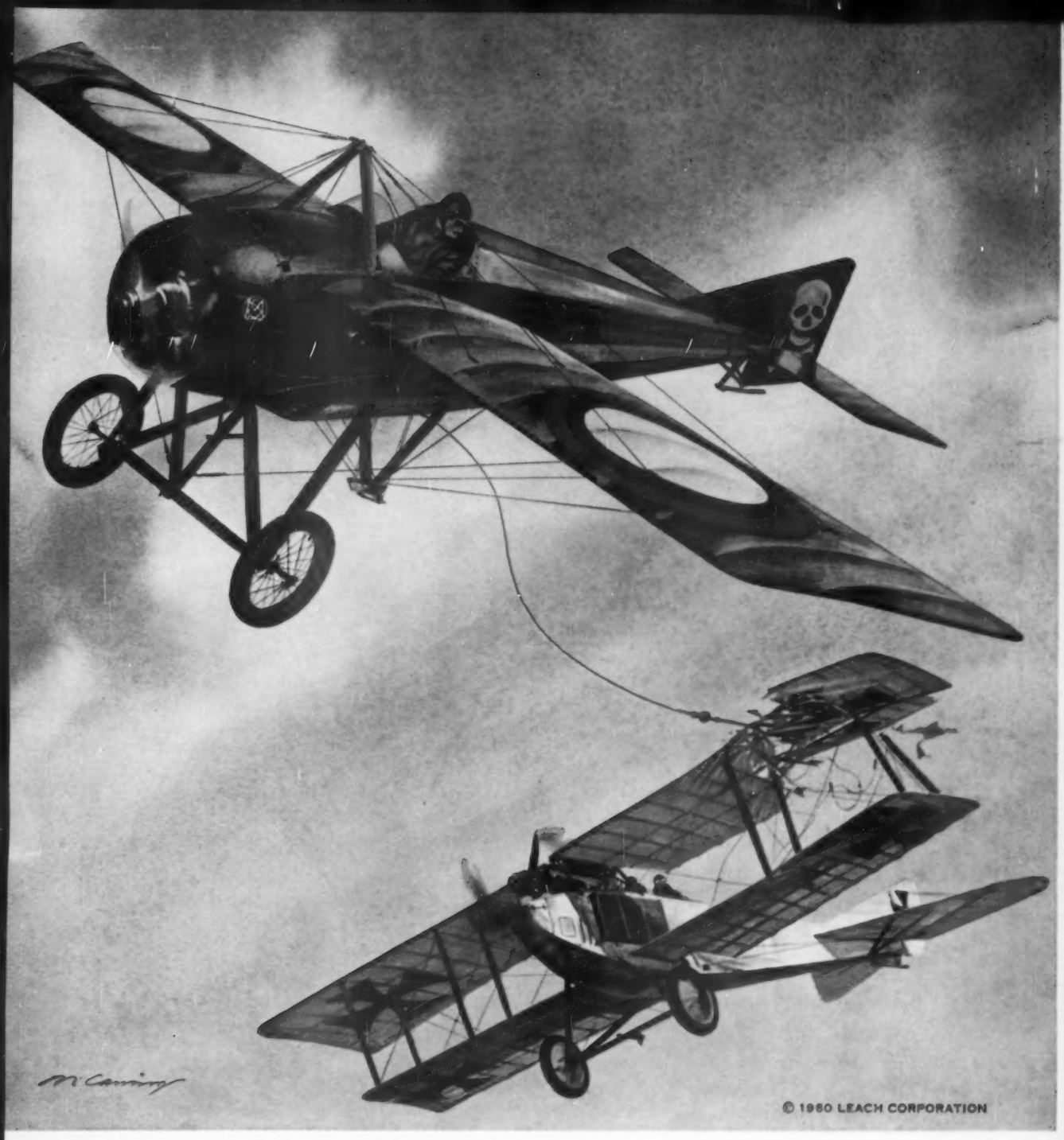
*POSITION—ATTITUDE—TRAJECTORY CONTROL SYSTEM



KAZAKOV AND HIS 'KATZE'

LEACH HERITAGE OF THE AIR — 10

The startled Germans couldn't believe their eyes. Behind them, trailing a five-pronged anchor and an iron ball, was a Russian pilot in a Morane scout. Before they could get away, the Russian struck from above and behind, swinging the anchor on its steel cable. As he turned, it hooked into the left wing of their two-seater Albatros. For a moment, the two planes were locked in combat, then the cable tore loose and the iron ball completely shattered the wing. The Albatros collapsed and fell.

Staff-Captain Alexander A. Kazakov, using a weapon unique in the history of aerial fighting, had scored another victory on the Russian Front. It was June, 1915.

The anchor or "katze" was part of an experiment that had interested Kazakov during his days at the Sevastopol Flying School, founded by the Grand Duke Alexander to train pilots for the Imperial Russian Air Service. To the katze, an old form of German battering ram, Kazakov added a medium-sized iron ball weighing about 20 pounds, which acted like a sinker above a fish hook.

It was Kazakov's last experiment with an untried weapon, but it was not his last aerial adventure. Before his career ended, Kazakov had scored 32 kills. He held every known Russian decoration for gallantry, received the French Croix de Guerre and served as a major in the British Army, which awarded him the Distinguished Service Order.

The plane Kazakov used in his katze attack was a French-built Morane-Saulnier scout, a wire-braced, mid-wing monoplane that first saw military service in 1914, principally with the French and British. It was powered by an 80-hp. Le Rhone engine to a maximum speed of only 78 mph. Fitted with a 110-hp. Le Rhone in 1916, the Morane reached a top speed of 102 mph.

STAFF-CAPTAIN KAZAKOV
Russia's most gallant ace

The best known of Russian World War I aces, Kazakov was quiet and modest — a born pilot gifted with a combination of daring and discipline.

He was a cavalry officer when Germany declared war on Russia in August, 1914, but quickly transferred to the air service.

In the spring of 1916 Kazakov was named to command Russia's 19th Squadron, the famed "death or glory" squadron formed on the Central Front. The 19th, used as a shock unit, preceded von Richthofen's "Flying Circus" by nearly a year.

With revolution rife in his country and an armistice signed between the Central Powers and Bolshevik Russia, Kazakov and several other Russian war pilots joined the Slavo-British aviation group in 1917 to fight against the Bolos.

When the Allied forces withdrew from Murmansk in the summer of 1919, Kazakov turned down a post in London to remain with his squadron. He and two comrades decided to join the White Russian army in Siberia, and on August 1 took off from Bereznik Aerodrome. His Sopwith Camel collapsed in mid-air and Russia's leading ace was killed instantly.

Heritage of the Air

One of the most inspiring chapters in the history of technical evolution is the story of the men and flying machines of World War I. It is the highly personalized story of brave men — and the wood, wire, linen, and rudimentary technologies that converted manpower to airpower. Today, Leach Corporation celebrates its 40th year in electronics with the presentation of this Heritage of the Air series.

• • •

Technical Director for Heritage of the Air is Major Kimbrough S. Brown, USAF.

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that means the same thing

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before it became "reliability"

"Reliability" doesn't mean a thing . . . not any more.

Repeated use has debilitated the word by eroding its meaning. In short, "reliability" is worn out, the victim of overexposure. If you doubt it, count the number of times the word is used between the covers of this magazine.

What can be done about it?

That's a problem for the wordsmiths. Ours haven't been able to come up with anything that means what "reliability" used to mean.

So we'll continue using the word, but we hope that next time you hear someone from Leach say "reliability" you'll remember it's just our way of saying:

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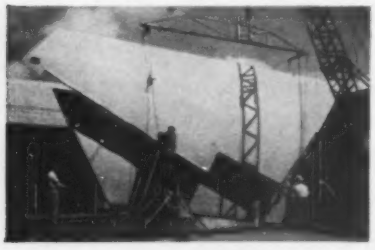

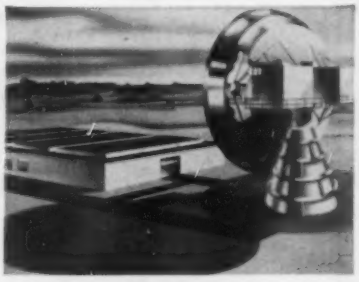

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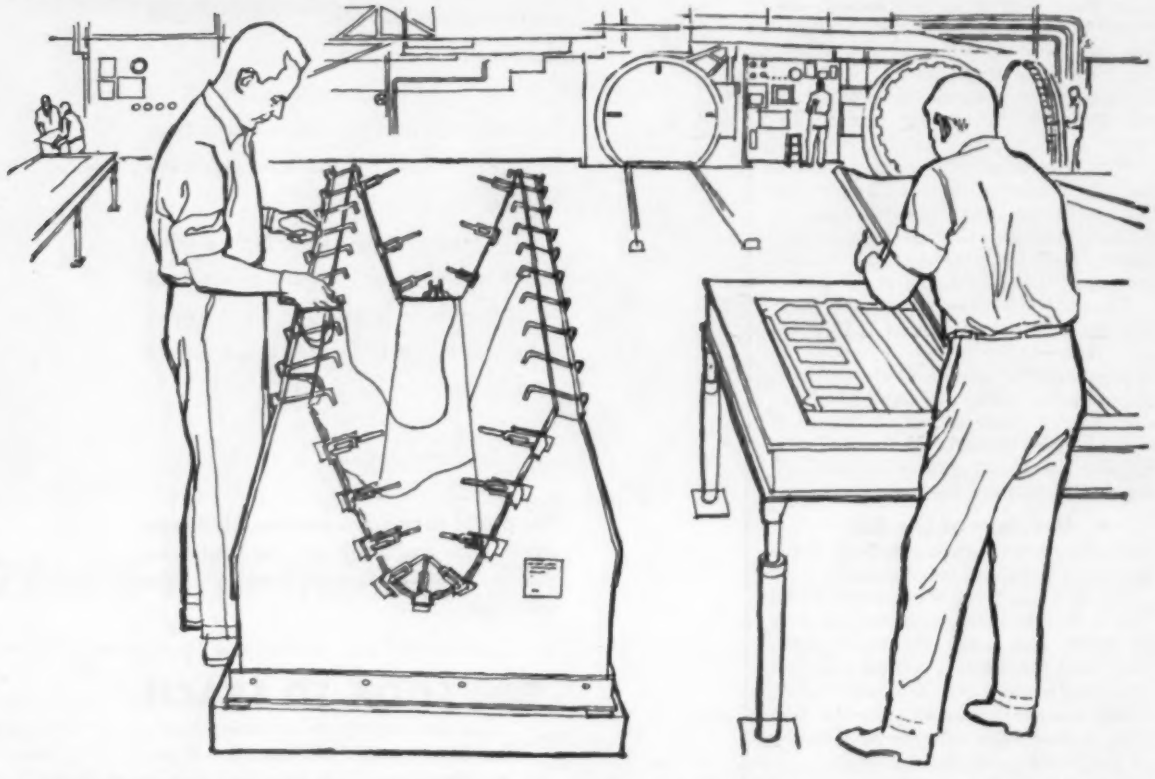

FAIRCHILD AIRCRAFT & MISSILES DIVISION
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FILTER CENTER

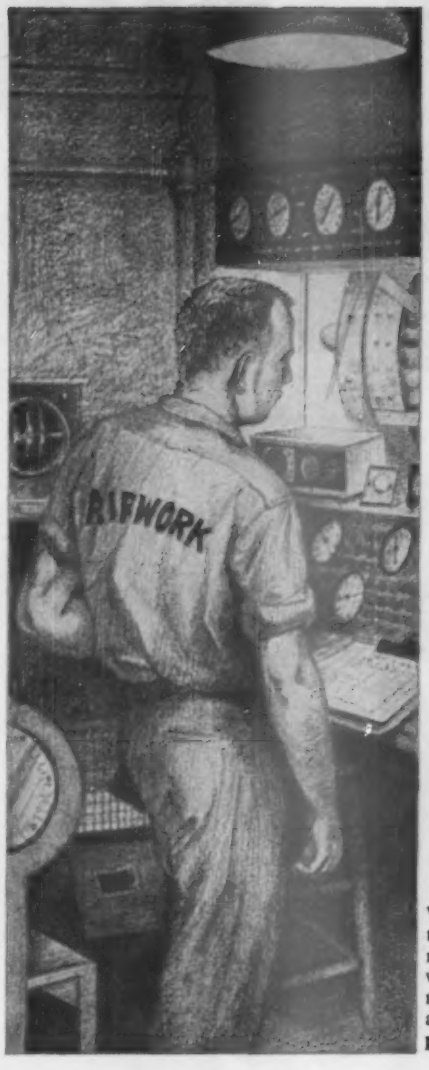
▶ **Deposited Components Improved**—Bell Telephone Laboratories has refined its process for making deposited thin-film tantalum capacitors and resistors for microcircuit use to the point where values can be fabricated with a tolerance of 0.5%, BTL's R. W. Berry and Nathan Schwartz reported during recent Military Electronics Convention in Washington. Capacitors are trimmed to desired value by cutting off a tab on one electrode. Resistors are trimmed by an anodizing process which shows promise of achieving tolerances of 0.1%. The thin-film tantalum resistors exhibit good temperature stability with less than 0.5% change in resistance after 1,000 hr. exposure to 100C temperature. Thin film capacitors have a temperature coefficient of 250 ppm per degree centigrade and have a dissipation factor of 0.01 at 1 kc.

▶ **New Tube for Space Telemetry**—Lightweight, long-life traveling-wave tube amplifier-oscillator, specifically designed for use in space vehicles, is being developed by Watkins-Johnson Co., Palo Alto, Calif., under Wright Air Development Division sponsorship. New TWT will operate in the 2,000 to 2,400 mc. band, deliver 10-15 watts power with an efficiency of 30%, according to a paper presented by H. R. Johnson and L. A. Roberts at the Military Electronics Convention. The tube, which employs electrostatic focusing, will weigh less than 1 lb. and can be voltage tuned over a frequency of 50 mc. Tube life is expected to exceed 10,000 hr.

▶ **Molectronic Computer**—Digital computer using molectronic techniques which Texas Instruments is developing for Wright Air Development Division, slated for delivery in mid-1961, is expected to measure only 4 x 4 x 1 in. in size. Program is sponsored by WADD's Electronic Technology Laboratory (AW Feb. 8, p. 79).

▶ **Submillimeter Generator**—Sperry Gyroscope Co. will begin experiments shortly leading to the development of a submillimeter wave (beyond 300 kmc.) electromagnetic generator for Wright Air Development Division under a $76,500 contract.

▶ **Delco Demonstrates Savvy Computer**—A digital computer that is wise in the ways of the world was demonstrated by Delco during the recent Military Electronics Convention in Washington. The device computes a visitor's age from "yes" or "no" responses of the



The Hours Here Are The Most Critical

Run-in is the most critical time in the life of an engine. Run-in burnishes the parts, guarantees, to an amazing degree, the successful life of the engine. More care in the test cell means more long term protection for your pocketbook.

Here's four typical Airwork Test Cell Extras that make sure your engine is ready for maximum service:

Oil pressures and temperatures are read in many different parts of the engine — helping us pinpoint possible malfunctions before they occur. The volume of oil moving through the engine is measured, too.

Ignition systems are checked with a Scintilla ignition analizer. This makes sure every component is interacting properly.

Oil consumption and fuel consumption are checked by extremely accurate instruments. We don't depend on dip stick tests.

An extra large oil and fuel filtering system extracts the most minute particles. Four times during the run, a lever dumps any foreign matter on a fine screen for visual inspection.

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AN/FSA-12--First to detect and process 3-D radar data automatically

The first equipment to successfully automate the processing of three-dimensional data direct from a working radar, the AN/FSA-12 (XW-1) has operated since 1958. This detector tracker has enabled General Electric to develop many improved radar techniques and equipment.

New concepts in correlation and smoothing in the track-while-scan method have been demonstrated. Delay lines applied to digital techniques and plug-in wiring boards have been improved. New ideas in data storage and digital circuitry have been applied.

This experimental model continues to be a proving ground in research and development of advanced military electronics. A completely solid state production version of the AN/FSA-12 will soon be available for many of our nation's air defense radar sites. 176-04

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GENERAL ELECTRIC

visitor to a series of questions, entered into the computer by means of two push buttons. Last of the questions was: "Are you female?" If the visitor answered "no," the computer displayed his true age. But if visitor was a female, machine always showed her age to be "21," unless it was less, in which case the true age was displayed.

▶**Avionics Vibration Guide for Designers**—Handbook for avionics designers on the subject of shock and vibration, their effects on airborne equipment and techniques for minimizing their effects, prepared by RCA Service Co. under Wright Air Development Division sponsorship, is now available from the Office of Technical Services, Commerce Dept., Washington 25, D. C. The 260-page handbook, "Electronic Designer's Shock and Vibration Guide for Airborne Applications," PB 161229, is priced at $4.00.

▶**Broadband Amplifier Detailed**—A broadband beam-type parametric traveling wave amplifier, called the Paratron, was described by Jerome Herman and James Litton, Jr., of Sperry Gyroscope before the recent Electron Tube Research Conference held in Seattle. The Paratron has minimum terminal gain of 25 db., with octave bandwidth in C band. Now in development, Paratron is expected to be an extremely low noise tube although no noise measurements were reported.

▶**Dopplers for Gulfstreams**—General Precision reports its Radan 500 doppler radar navigators have been installed in two Grumman Gulfstreams, believed to be the first executive plane installations of such equipment. Installations were made by PacAero Engineering Corp., Santa Monica, Calif.

▶**Deadly Polaris Accuracy**—Three separate inertial navigation systems to be carried by each Polaris missile-bearing submarine as part of its Ships Inertial Navigation System (SINS) will be corrected on a staggered basis by readings from peripheral navigation aids to enable Polaris submarines to locate their positions to within ¼ mi. Correcting errors due to long term gyro drift in inertial system on a staggered basis increases assurance that submarine's position has been verified recently and can be fed into missile fire control at any given time.

▶**USAF Bionics Meeting Scheduled**—Wright Air Development Division will sponsor a two-day conference on Bionics (information handling systems based on living models), Sept. 13-14, at Biltmore Hotel in Dayton. Conference will include sessions on the life sciences in bionics, analysis of biological principles, physical analogs of biological components and subsystems and mechanical realization of the higher functions of living systems. For additional information, write Maj. J. E. Steele (WWRDA), Wright-Patterson AFB, Ohio.

▶**Broadband, High Frequency Maser**—Engineers at RCA Defense Electronics Products are working on what is expected to be a high gain, large bandwidth traveling wave rutile Maser which will operate at 35 kmc. Amplifier may employ varying pitch, copper meandering line mounted on mylar strip as a slow wave structure.

▶**GSE Directory Available**—Directory of military agencies responsible for development of missile ground support equipment, prepared by Defense Department, listing both agency and responsible individual within the agency, is now available from Office of Technical Services, Commerce Department, Washington 25, D. C. Publication, entitled "Technical Resources Directory—Missile Ground Support Equipment No. 2", PB-161535, is priced at 50 cents.

▶**Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

• **Avien, Inc.**, Woodside, N. Y., will produce jet engine time temperature recorders (AW May 23, p. 87) for the Bureau of Naval Weapons under an $88,000 contract; oil temperature indicating and warning system for the Boeing B-52H bomber under an $85,000 contract from Boeing Airplane Co. and fuel quantity gaging system parts for Middletown Air Materiel Area under a $140,000 award.

• **General Electric's** Heavy Military Electronics Department will produce 65 anti-jamming modification kits for AN/FPS-6 height-finding radars under a $2.5 million order from Rome Air Materiel Area.

• **Delcon Corp.**, Palo Alto, Calif., will make 300 VHF mobile radio stations for the Federal Aviation Agency to be used for ground portions of two-way communication between ground and aircraft by Airways Aids Stations. Order for $104,000 is said to be the new firm's first major contract.

• **Philco Corp.** will develop, produce and modify height finder radar system for Airborne Long-Range Input under a contract exceeding $3 million.

• **Hughes Aircraft Co.**, Culver City, Calif., $7.5 million contract to build inertial guidance systems for the Polaris fleet ballistic missile. Under contract, Hughes and Minneapolis-Honeywell jointly will be a second source for Polaris guidance which also is being produced by General Electric (AW May 2, p. 37).

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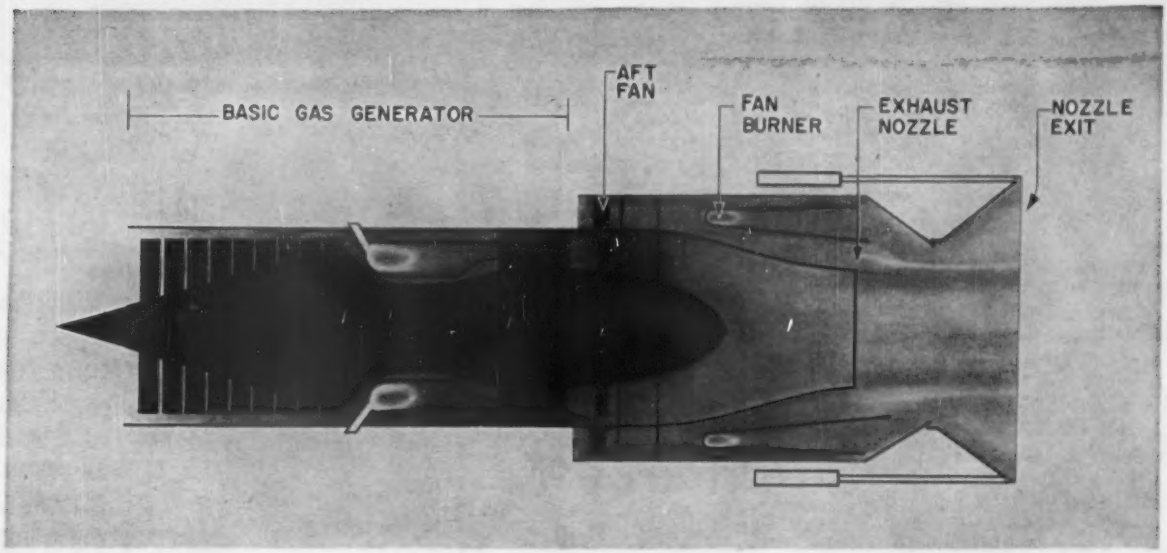

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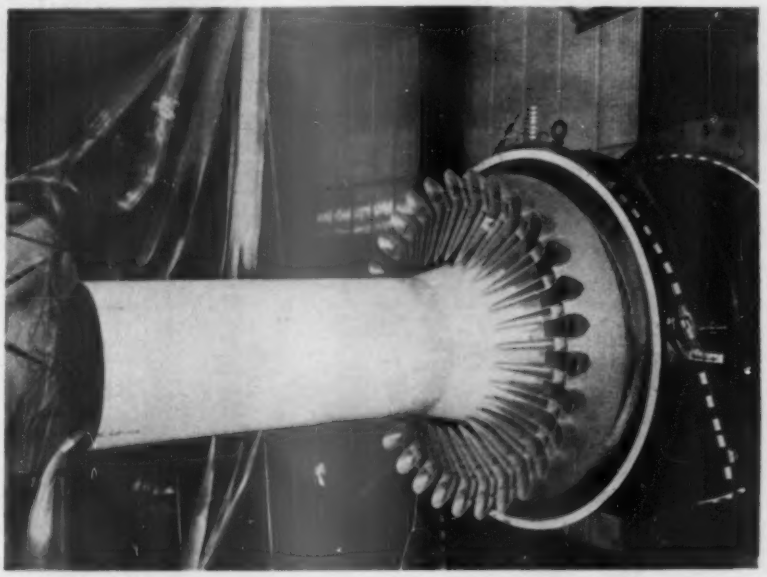

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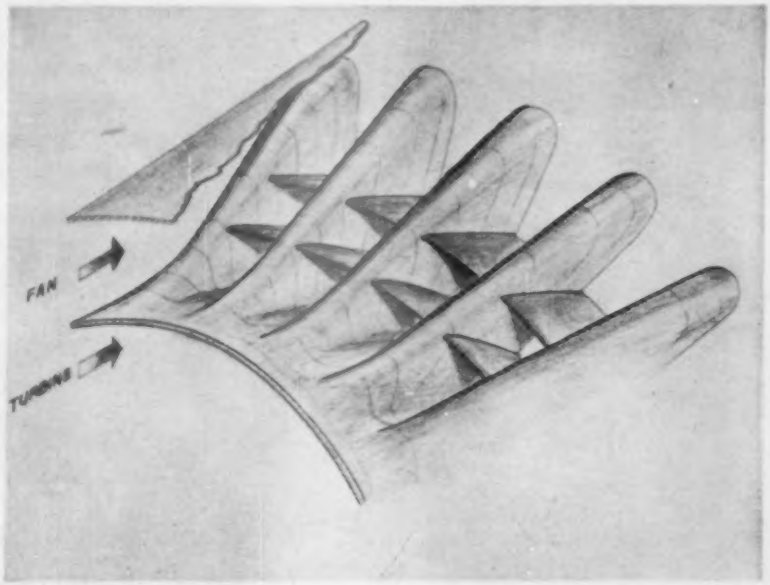

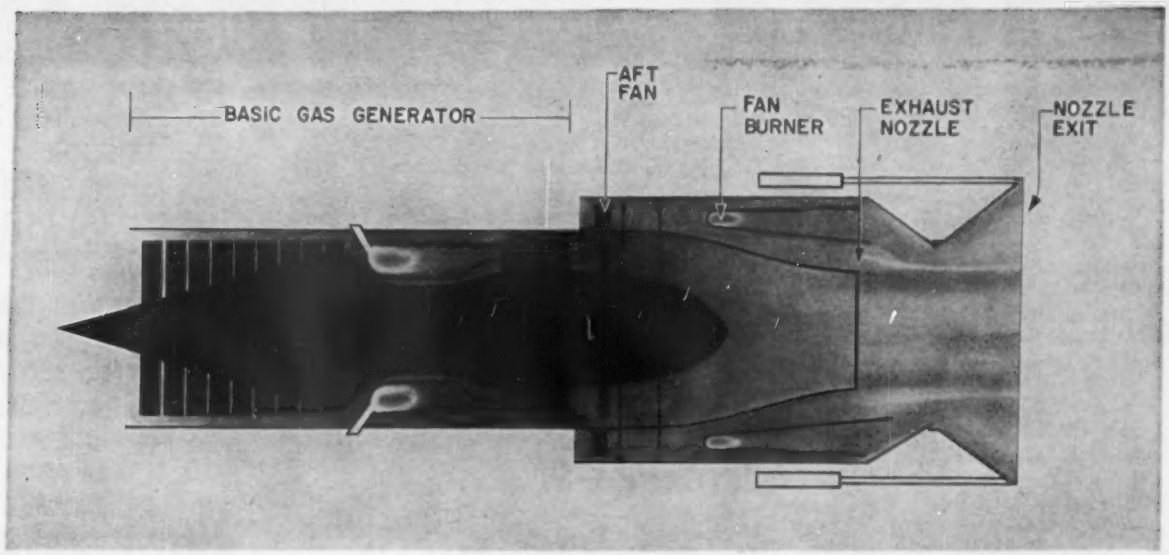

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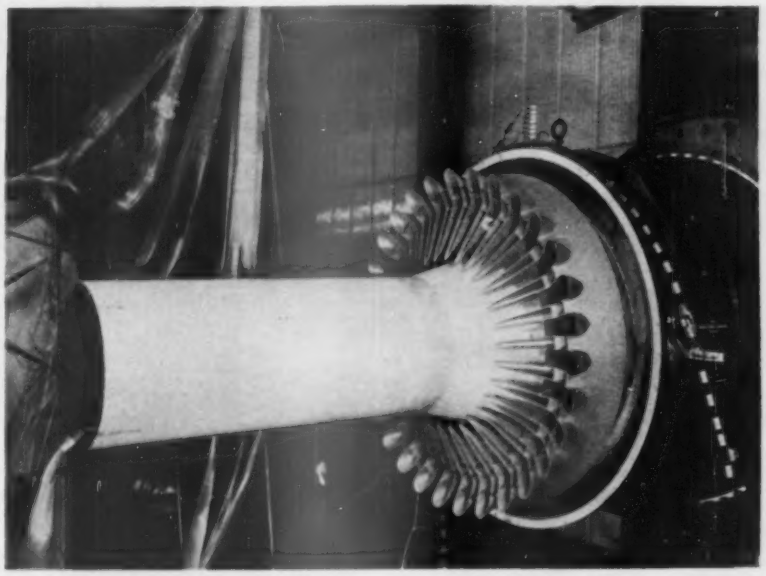

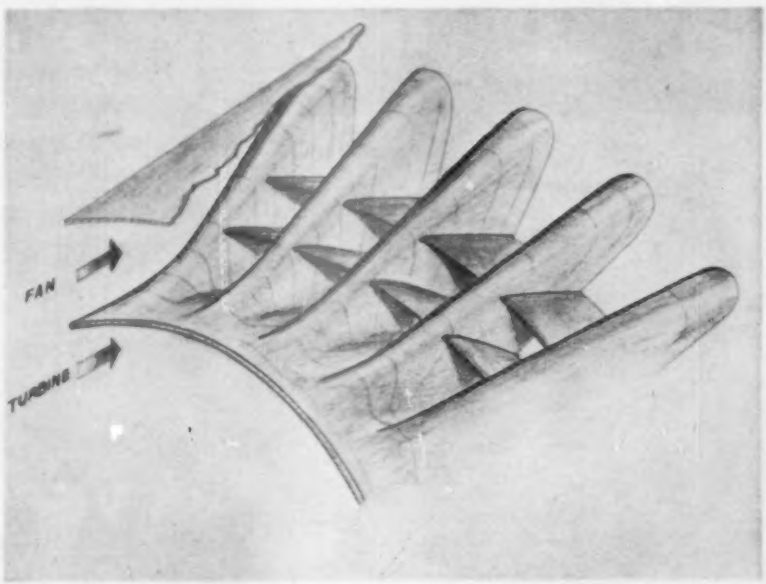

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For complete details on the Vertol 107-Model II, write: Commercial Sales Manager.

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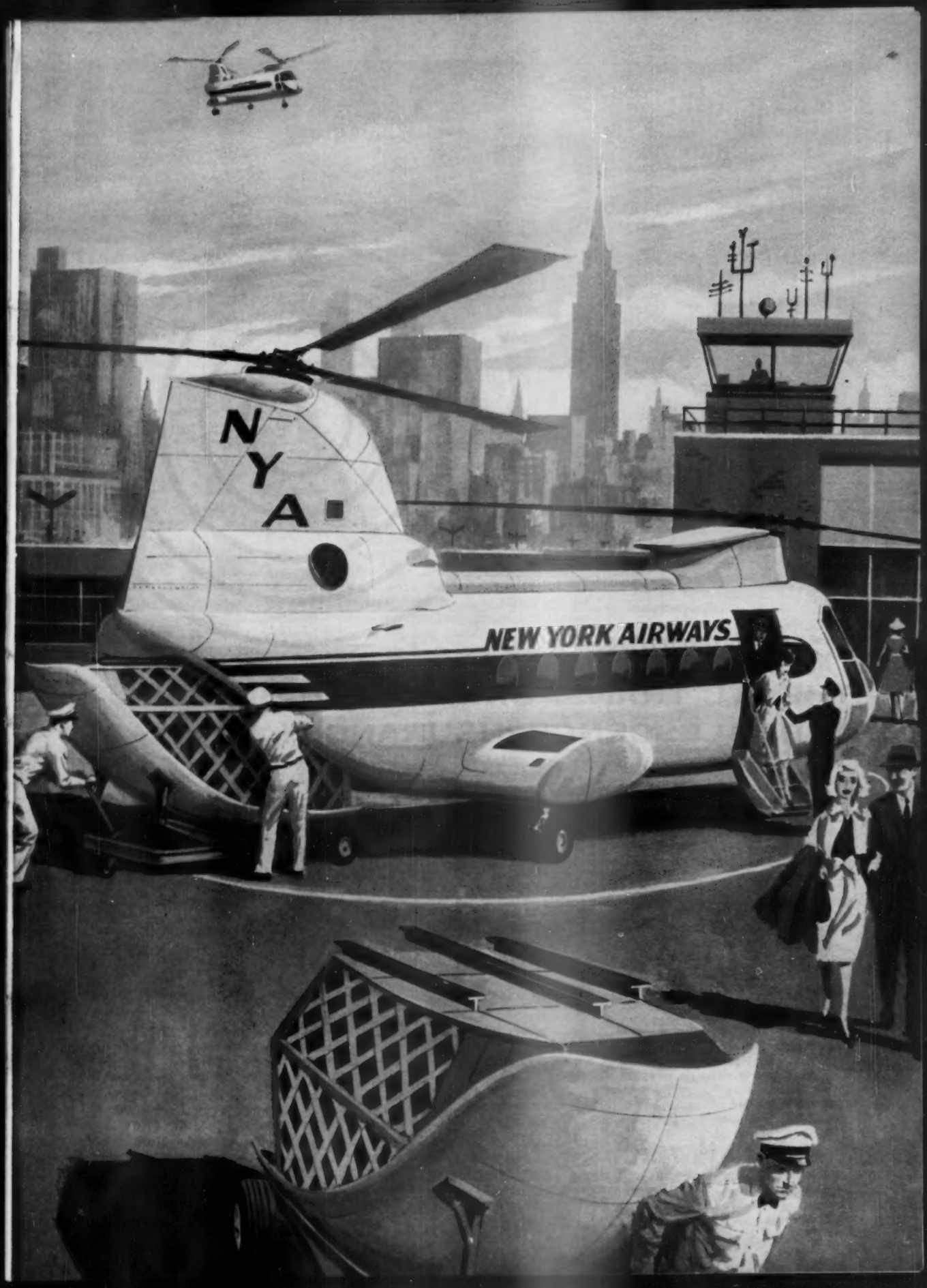
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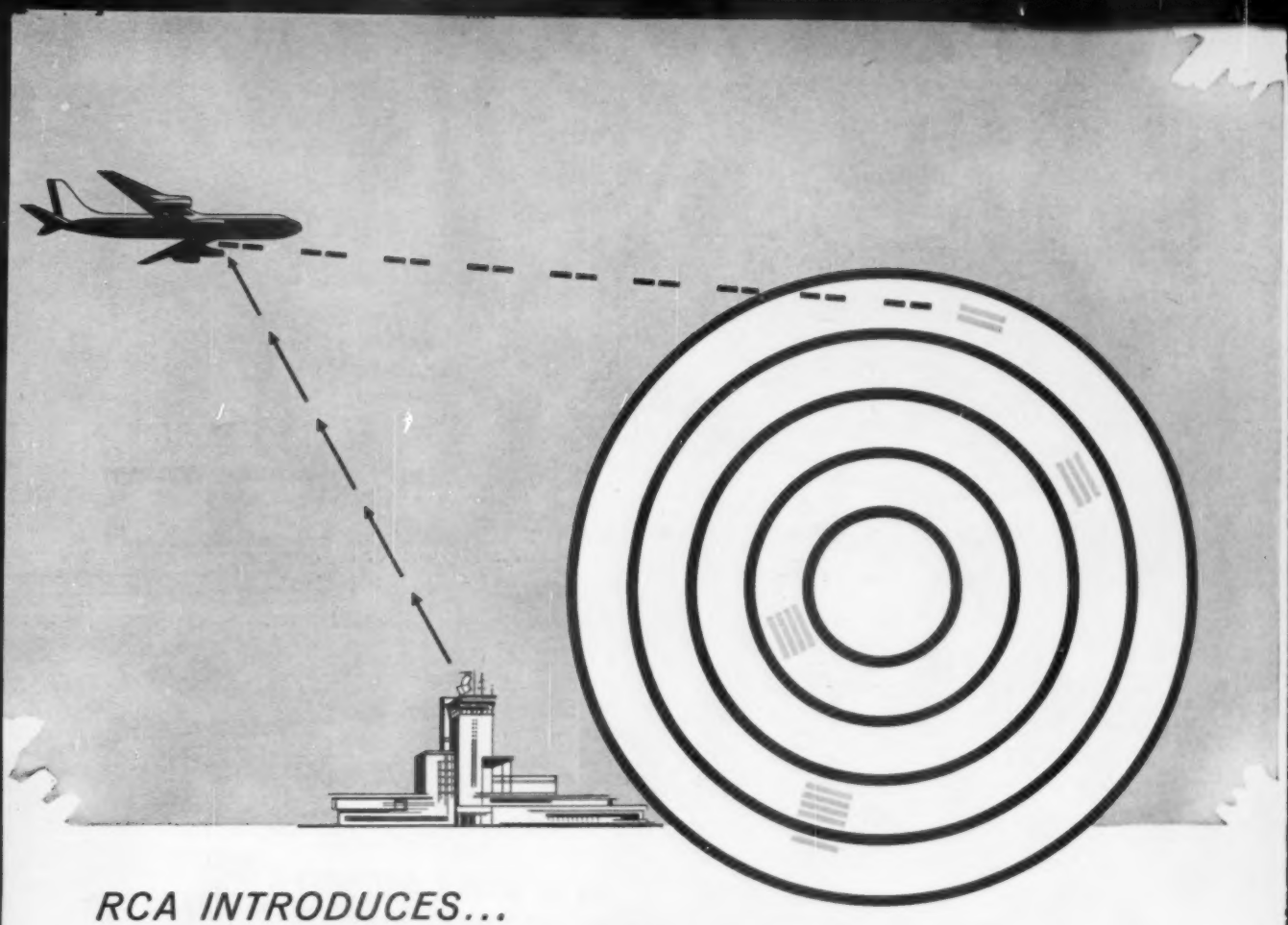

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RCA's new AVQ-60-B Transponder provides ground control centers with positive, instant and automatic identity and location of aircraft, independent of the pilot. Transponder-equipped aircraft, by expediting this identity procedure, contribute immeasurably to more rapid and precise air traffic flow.

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To assure compactness and durability and to minimize the heat dissipation problem, the AVQ-60-B has been designed with transistors where they will serve best. Regulated power supplies provide stability under all environmental conditions. Built-in obsolescence insurance, compactness, efficiency and light weight make the AVQ-60-B Transponder the best equipment-value of its kind in the industry.

Our Sales Engineers will be glad to give you full details on the RCA Transponder in your aircraft. Write or telephone: Radio Corporation of America, Aviation Division, 11819 W. Olympic Blvd., West Los Angeles 64, California.

The lightness (only 26 pounds including mounts) and compactness (due to transistors) make the AVQ-60-B applicable to aircraft with rigid space and weight limitations. Sectionalized plug-in chassis construction is used throughout for easy maintenance accessibility.

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COMBUSTOR for the fan stream on a fan burner engine is shown in the left portion of the experimental air duct above. Combustor was tested by GE in 1956 over full range of operating conditions for a fan burner engine suitable for use on a Mach 3 transport.

creased performance is greater engine diameter. The fan burner engine will be lighter than a full afterburning turbojet to produce a given level of thrust at cruise conditions if burning in the fan section is kept low. The fan burner also will have lower specific fuel consumption and will provide greater takeoff thrust.

Detail Design

A few detail design features of a fan burner engine will be peculiar to it, but many more will be common to all types of supersonic turbojets. A general description of the components of a fan burner engine, based primarily on studies by the General Electric Co., follows:

• **Installation.** All types of supersonic ducted fan engines probably will have only one inlet for air and only one exhaust nozzle. In contrast, some nacelles for subsonic fan engines that are being offered to the military and the airlines have one inlet for fan air and another for main gas generator air. Others have two nozzles so that the fan exhaust and the gas generator exhaust mix after they have left the engine.

Such installations will be awkward on supersonic engines because variable geometry will be required on all inlets and exhaust nozzles to achieve adequate performance. To reduce the weight and complication of variable geometry mechanisms, all fan burner engine air probably will enter in one inlet and be exhausted on a common nozzle. Further simplicity in variable geometry installations is possible through combining the inlets or exhaust nozzles for several engines. Two inlets are used on the B-70 to feed air to six engines.

• **Compressor.** Compressor design requirements are not stringent compared with those on the high performance engines now flying. Some designers say the compressor could be built with 10-year-old aerodynamic principles. The compression ratio will be moderate, probably in the range of five to eight. Pressure rise in each stage will be low so that the compressor probably will have 9 to 12 stages. Current high performance engines operate with compression ratios around 13 and have 17 and more compressor stages.

Only a moderate engine compression ratio is needed on the supersonic cruise turbojet because the ram pressure rise in the inlet is high. The determining design consideration probably will be to provide enough compression within the engine to give adequate fuel consumption at subsonic speeds.

Another design-easing feature of the supersonic engine is that its outside diameter is fixed by its large exhaust nozzle. This relieves the compressor design requirement of current engines, which calls for small frontal areas and low hub-to-tip ratios so that blades must be long and highly loaded to get sufficient air flow at maximum speeds. The supersonic fan burner compressor can have a large frontal area with a large hub and relatively short, lightly-loaded blades.

Critical Problem

One of the most critical design problems with the compressors on supersonic engines is a low effective stall margin which results from the flow distortion common to all types of supersonic inlets when they operate even at a small angle of attack. When flow distortion exists one side of the engine must accept a greater mass of air than the other and there is an unequal pressure distribution at the compressor face.

General Electric is considering two methods of reducing the effects of inlet flow distortion. One is low blade loadings on the early and middle compressor stages and the other is variable compressor geometry in the form of variable position stators. Low blade loadings help damp out pressure fluctuations and variable stators can be tied into the inlet

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control system to compensate for fluctuations also.

Variable stators have been used on the early stages of GE engines in the past to reduce the mass flow at starting and low speeds, and they are opened up at high speed to allow maximum air flow through the engine. It is probable that more stages of variable stators will be required on supersonic cruise engines to perform these functions and to help correct inlet distortion.

Compressor blading will be of the transonic type, with supersonic speeds at the tip and subsonic flow at the hub, which has been in use for many years.

• **Combustor.** Operating temperature in the combustor of the gas generator of a Mach 3.0 fan burner engine will not run more than 100F hotter than the combustor of a J79 engine, which is about 900F. Main improvement in the fan burner combustor will be in improved materials and longer life.

• **Turbine.** Primary design objective in the turbine section of a commercial fan burner engine will be to achieve long blade life—at least 3,000 hr. Turbine operating temperature probably will be around 1,850F. Designer's choice will be either to add the complexity of using air-cooled blades to get an improvement in life or to use solid blades and save power and initial cost.

• **Fan Blading.** Single stage compressor is used in the fan section of a GE fan burner engine. The blades have a circular arc section and are capable of providing pressure ratios of considerably better than two. Most fan engines under consideration have fan pressure ratios under two so the blades have a wide stall margin. The high performance and efficiency of these single stage compressors make it highly unlikely that two stages will be needed in the fan section of any high speed ducted fan engine.

'BLUCKET' BLADE is attached to a section of the fan rotor above. Upper portion of the blucket is a fan compressor blade, and the lower portion is a turbine blade used to drive the rotor. Center bulge is part of the shroud to cut down vibration.

Blades on the fan compressor of current GE aft-fan engines are actually the outer section of the turbine blades that drive them. The combined component is called a "blucket" and no major change is expected in it for use in fan burner engines. The forward part of the fan section consists of a wheel of these bluckets placed just behind the low pressure turbine on the gas generator. This wheel is connected to the gas generator solely through the gas stream. This aerodynamic coupling arrangement between the fan flow and the gas generator flow has not given the GE fan engines different throttle response characteristics than the basic gas generators that drive them. The blucket wheels have low inertia and they respond almost instantaneously to changes in the gas generator flow.

Two main design problems of the blucket type of installation have been overcome in the development of the aft-fan engines now approaching commercial service. These problems are not expected to give trouble on fan burner engines even though the fan burner will develop more power in the fan section and probably will require two free turbine stages to drive the one-stage fan compressor.

First problem is vibration of the long blucket. This is overcome by using a heavy shroud as a support between the compressor and turbine portions of the blade. This support shroud is segmented and a portion of it is an integral part of each blucket.

The second problem is uneven heating of the blucket, because part of it is in the hot gas generator exhaust and part in the cold fan inflow air with a temperature differential in the neighborhood of 1,000F. It has been possible to eliminate serious temperature gradients and thermal stresses in the blucket by designing for good heat con-

Lockheed Rolls Out First Production JetStar

First production model of the four-engine Lockheed JetStar has rolled out at Marietta, Ga., and will begin flight-test this month. Four-engine configuration (Pratt & Whitney JT-12s producing 3,000 lb. thrust each) have been tested on a JetStar prototype (AW Mar. 21, p. 33). Glove tanks hold 640 gal. each, pushing the range to 2,900 mi.

duction through the blade and by letting a small portion of hot gas go through the seal ahead of the blucket wheel so that the fan inlet air is heated. The support shroud is a part of the front and rear seal on the blucket wheel. Anti-icing is not required for the fan compressor stage with this design because the fan blade operating temperatures are several hundred degrees Fahrenheit.

• **Fan Combustor.** Combustor in the fan stream of a fan burner engine will present a slightly different design problem than the combustor in the main gas generator or in an afterburner because it must support combustion at a relatively low pressure. Combustor in an afterburner, where the pressure is high, usually is nothing more than a flame holder of light metal bent into a "V" shape to create a small turbulent area. Design of the gas generator combustor is more involved to provide complete combustion at a lower pressure in a short distance. Very low pressure combustors needed in the fan stream of fan burner engines have been tested successfully for several years by GE and other engine firms.

• **Exhaust Mixer.** An exhaust mixer will be required just before the exhaust nozzle on a supersonic burner engine to efficiently mix the flows from the fan section and the main gas generator. Even if it were practical on a supersonic engine to exhaust the flows through separate nozzles and have them combine outside the engine, this arrangement does not give the maximum in propulsive efficiency. It has been proven by GE engineers and others that if two streams of different momentum and thrust are combined and then exhausted through a common nozzle they will provide a greater total thrust than if they are exhausted separately.

Main exhaust mixer design objective is to have the fan and gas generator streams mix efficiently over the engine's whole operating range. A number of mixer configurations are possible but in general they resemble noise suppressors on subsonic turbojets. The fluted or daisy type mixer shown on page 97 is typical. It provides a large mixing surface and it gives the designer a maximum opportunity to adjust the flow area for each stream and thereby control its pressures. A mixer is most efficient when the static pressures in the streams are equal just before they are combined. This keeps turbulence at a minimum. It is also advantageous to have the velocities equal so that shear losses are minimized. In general it is preferable to mix by speeding up the slow stream to achieve a pressure balance rather than slowing down the fast flow.

• **Nozzle.** Exhaust nozzles with exit-area-to-throat-area ratios that can be varied over a wide range are necessary on any engine which must operate well from static conditions up to 2,000 mph. and above. At high supersonic speeds, the exit area of the nozzle must be very large compared with the throat area. This provides a large conical surface for the high pressure exhaust flow to push against as it expands down to the pressure of the ambient atmosphere. This large expansion ratio nozzle is not efficient below cruise speed and at takeoff because the exhaust flow will not fill up the nozzle, and becomes turbulent. The nozzle area ratio must be reduced under these conditions and the exit area reduced.

Aerodynamic Nozzles

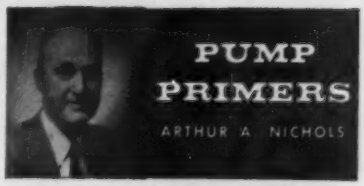
If nozzle efficiencies are to remain near 95% under all flight conditions for the Mach 3.0 class transport, a variable geometry nozzle that is more sophisticated than those on the Mach 2.0 military aircraft now flying probably will be required. Area ratio control on most of these "aerodynamic" nozzles is achieved partially by moving solid surfaces and partially by deflecting the exhaust flow with high pressure streams of air.

Required range of area ratios becomes so large above Mach 2.0 that "aerodynamic" nozzles are generally regarded to be inadequate. Completely mechanical nozzles for this speed range generally are difficult design problems. Usually they have two sets of movable surfaces, one set to contract the flow into the throat and another set to form the expansion cone beyond the throat. A great deal of work by engine companies and government agencies has gone into the development of reliable lightweight nozzles of this type and they are now regarded as within the state-of-the-art.

Another type of exhaust nozzle—the plug nozzle—has no moving parts, yet tests have shown that it can operate efficiency at sea level and at very high Mach numbers at high altitudes. The plug nozzle has been described as a conventional convergent-divergent nozzle turned inside out.

Its exhaust flow passes through an annular nozzle and then is directed against a long conical plug running aft out of the middle of the nozzle. As the exhaust stream expands, the plug forms one boundary for the flow and the atmosphere the other. As the atmospheric pressure drops, the flow stream is allowed to expand and there are no losses due to overexpansion outside the nozzle.

The effective exit area of the plug nozzle is the area of the flow at the tip of the plug. Since the flow area at this point adjusts naturally to the pressure of the outside atmosphere, nozzle area ratio is changed without the



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Structure and operation of the Gerotor pump is relatively simple. The moving elements are the toothed "Gerotors" — inner and outer. Both turn in the same direction and either one may be driven. The inner element always has one less tooth than the outer and the "missing tooth" provides a chamber to move the fluid from the inlet or suction port to the discharge port. (See Figure 1).

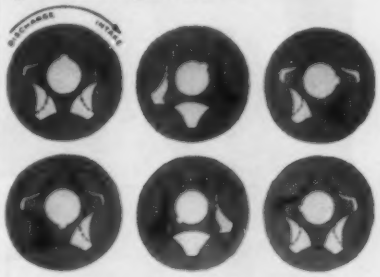

FIG. 1

Low relative speed and closely held clearances between the two Gerotor elements mean high mechanical efficiency is maintained.

Slow opening of the chamber as it traverses the large inlet and discharge ports results in avoidance of the sudden shock, rapid pressure change and turbulence which, in other types of pumps, results in foaming and lowered efficiency. Thus, Gerotor pumps offer exceptionally good performance at high altitude.

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Economical service like this is extremely important to both commercial and military jet operations. In fact, this Thermoid-Quaker "Dacron" and Silicone rubber jet-starter hose was developed for military use, and is used by the government. "Dacron" cross-braid construction distributes the load evenly, prevents kinking; and the seamless silicone rubber tube and bonding layer resist heat and provide flexibility under low temperatures.

Get complete information, including Technical Data, on Thermoid-Quaker Jet-Starter Hose from your Thermoid Division industrial distributor, or write *Thermoid Division, H. K. Porter Company, Inc., 200 Whitehead Road, Trenton 6, New Jersey.*

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need for any variable geometry or automatic control system.

Plug nozzles for turbojets have been under development for some time by many engine companies. The only operational plug nozzle today is on the Pratt & Whitney J52 installation on the North American Hound Dog missile.

Performance of the plug nozzle has proven to be competitive with the variable geometry convergent-divergent nozzle.

They will provide roughly the same thrust coefficients under most flight conditions. The plug nozzle is lighter because it does not need a mechanical mechanism to change its dimensions. Its main disadvantage is a more stringent cooling requirement because the plug is located inside of the exhaust stream.

The greater number of engine operating variables characteristic of fan burner engines makes analysis of them somewhat more difficult than for current turbojets but at the same time provides more ways to do the same job. A typical paper engine designed by GE to meet the requirements of a Mach 3.0 commercial transport would have the following percentages of its total power produced by its fan section and gas generator—during sea level takeoff without burning in the fan section, the gas generator would produce 55% of the exhaust energy and fan stream 45%. These percentages would be reversed during transonic acceleration and climb when fan burning was used. At Mach 3.0 cruise with little or no fan burning the fan section would account for 60% of the exhaust energy.

Hope Raised

The facility with which the operating parameters of the fan burner engine may be varied has raised some hope among powerplant engineers that it can be used to ease the very difficult job of designing supersonic inlets. In this respect it may prove possible to largely overcome the air spillage problem when the entrance or capture area of a supersonic inlet remains fixed over a wide Mach number range.

The air spillage causes high drag so that today the entrance area must be variable and any excess air must be dumped efficiently at some location aft of the inlet. The hope is that the thrust of the fan burner turbojet can be kept constant while the total air mass flow through the engine is varied by changing the percentages of energy produced in the fan section and the main gas generator. If this can be done the complexity of the inlet's variable geometry mechanism can be reduced by keeping the capture area constant and only varying the throat area.

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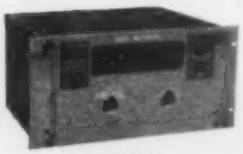

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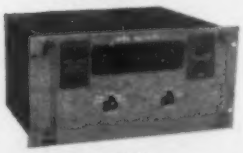

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MODEL 044
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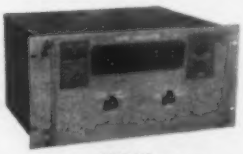

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Based on the original Airpass, part of the Lightning P.1B weapon system, the development is being financed by Ferranti, Ltd., Edinburgh, as a private venture. Saab has already specified Airpass II as standard for its advanced Drakens for the Royal Swedish Air Force.

Major reason for the development is foreign interest in a fire control system with a "ground mode" form of operation, permitting the use of the equipment against ground targets and as a low-flying navigational aid. Mapping and terrain clearance features are built into the new system.

Primary goal was to increase the versatility of the sighting system without making it appreciably larger or heavier. Airpass system developed for the English Electric Lightning is a single package carried inside the intake "bullet" nose of the plane. The pointed radome serves also as the aerodynamic spike to force the initial shock wave. Behind the radome is the faired container which houses all the rest of the avionic equipment associated with the system except for the sight itself and the pilot's controls for the sight.

Design objective for the system was to meet attack of conventional weapons. In addition, being specified for the P.1B meant that the accent would be on air-to-air interception modes of attack. Thus the first function of both systems is to provide air-to-air radar

AIRPASS components, laid out at left before nose of a Canberra jet bomber, include (left to right) hand controller, attack sight, radar display, fire control computer and radar.

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...NEWS IS HAPPENING AT NORTHROP
This thirty-first parachute decal denotes the successful completion of as many surveillance missions. Informally dubbed "Repeater" by its crew, this is not an unusual SD-1. Many Radioplane SD-1 drones have exceeded "Repeater's" record, because Radioplane designs these systems to be rugged, simple, and *reliable*.
REPEATER

ARMY'S SD-1 RACKS UP 31 MISSIONS ...READY FOR 31 MORE!

At the Army Electronic Proving Ground, Fort Huachuca, Arizona, tough little SD-1 drones from Radioplane perform mission after mission training troops in the tactical use of drone aerial surveillance. Under the direction of the U.S. Army Combat Surveillance and Target Acquisition Training Command, they are launched and return with photo intelligence within minutes. The SD-1 serves our tactical organizations in the U.S. and overseas in Europe and the Far East.

Reliability is the keynote in Radioplane design whether the product is a tactical SD-1 drone like "Repeater," a target missile, or a landing system for a space vehicle.

PILOTLESS AIRCRAFT
FOR AERIAL SURVEILLANCE
FOR TARGET TRAINING
FOR WEAPON SYSTEM EVALUATION

RADIOPLANE
A Division of **NORTHROP CORPORATION**
Van Nuys, California, and El Paso, Texas

search and automatic target tracking. Second function common to both is to provide radar assistance for either blind or visual attacks using a variety of air-to-air weapons. The Lightning uses cannon, unguided rockets and de Havilland Firestreak infrared homing missiles.

The radar assistance has been extended in Airpass II to help the pilot attack surface targets. Because he would normally approach these targets at low level, the radar portion of Airpass II can be used for ground mapping, for contour flying with warning of obstacles or for indication of terrain clearance. In the latter case, the design gives the pilot steering signals so that he can follow a specific course and clear obstacles en route.

Original Airpass system uses radar scanning during the search phase and presents this information to the pilot. When he identifies a target, he locks the radar beam onto automatic tracking, and the approach computer in the system gives him signals to follow to make the interception or the attack. This system is not completely automatic, but depends on the pilot to close the loop.

Sight presents both a radar display and optical aiming at the pilot's choice. Radar hand controller is installed on the left side of the cockpit and used by the pilot to aim the scanning roughly in the direction he chooses. First photos of Airpass system for the Lightning were shown in AVIATION WEEK (Sept. 28, 1959, p. 64).

Israel Orders 26 Mirage 3 Fighters

Paris—Israel next year will begin taking delivery of its first batch of French Dassault Mirage 3 interceptors.

The recent Franco-Israeli contract marks the first export success of this French aircraft. Details of the contract have been kept secret and no official announcement will be made. This procedure, requested by Israel, was followed in past years when France sold Mystere jet fighters and Vautour jet bombers to the Israeli air force.

French industry sources, however, indicated that the initial quantity ordered by Israel was 26 Mirage interceptors plus an option on an additional 14. Price of each aircraft was reported fixed at $2,500,000. This price is slightly higher than the French quoted when trying to sell the Mirage 3 to West Germany.

French are also hoping to sell the Mirage to the Australian air force. An Australian mission currently is studying the aircraft in France. French air force has ordered 200 Mirage 3s with initial deliveries slated to begin this September.

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IN SMALL PACKAGES

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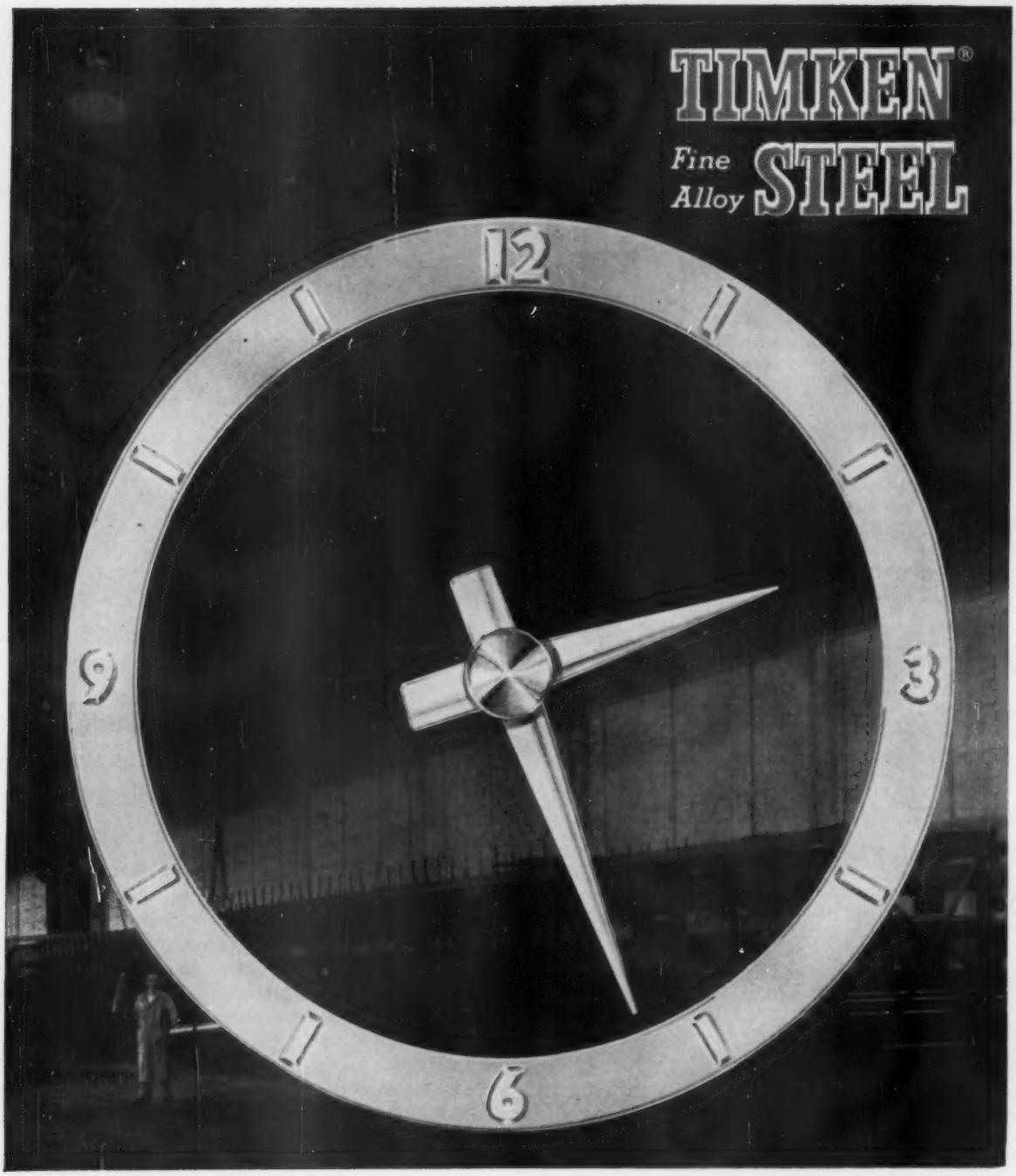

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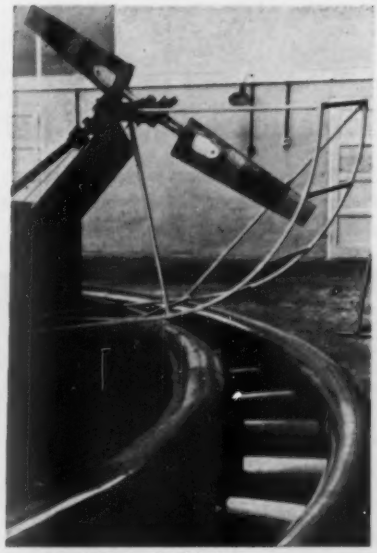


FORWARD propulsion of the Britten-Norman Cushioncraft is supplied by two Hiller tail rotors; note safety guard (right).

Cushioncraft Designed for River Travel

By John Tunstall

London—Variations on the fundamental Cockerell N-1 hovercraft principle have halved the structure weight, appreciably slashed initial costs, improved the aerodynamic characteristics of the cushion principle and lowered jet velocity, in a new cushion vehicle which made its first public hover trials recently.

Backed by Elders and Fyffes, Ltd., banana growers and shippers, the new vehicle was designed and developed in just under eight months by two former de Havilland Aircraft engineers, John Britten and Desmond Norman of Britten-Norman, Ltd., Bembridge Airport, Isle of Wight.

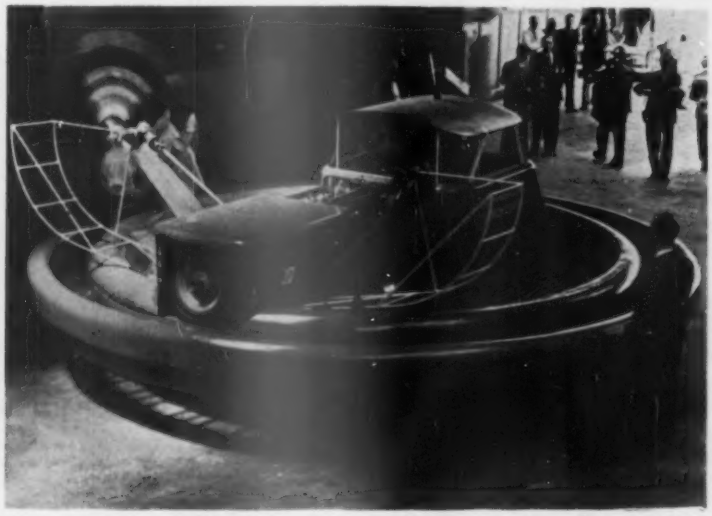
The design was instigated by the shippers to see whether a rudimentary, amphibious cushion vehicle, optimized for the purpose of transporting bananas over short jungle or river segments before shipment, could be made an economic proposition. Speeds above 40 mph. were unnecessary.

Main advantages included:

- **Avoidance** of extensive wastage due to bruising on road journeys to the docks, when the fruit ripens.
- **Cost of preparing** a rudimentary cushion track less than one tenth per yard of an all-weather road.
- **Independence** during the drought season at plantations having only river access.
- **Exploitation** of new plantations previously inaccessible because of high road costs.

Only the Cockerell principle had the necessary rugged amphibious capacity, Norman told AVIATION WEEK, but an inexpensive development with minimum operational flexibility and control sophistication did not look possible based on the same configuration.

The prototype demonstrated weighs one ton empty—the minimum economic size—has a circular planform 19 ft. in diameter, and can carry a driver,

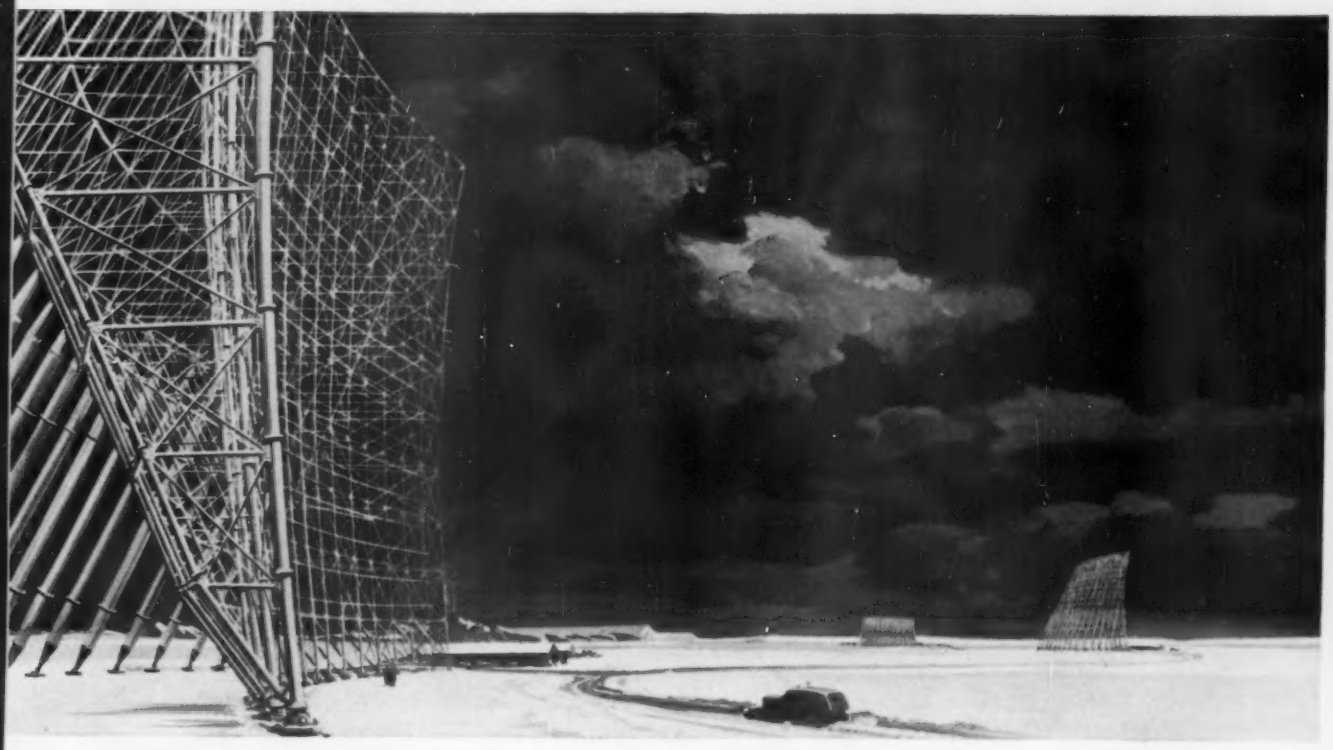


ANNULAR FAN has no hub and operates in three planes by nests of wheels; fan is driven by a sports car engine, transmission and road wheel (left). Intake air passing over annular shroud ring provides 15% of the lift. Vehicle is all-wood structure.

This mark tells you a product is made of modern, dependable Steel.

Somewhere North of Baffin Bay

The Arctic is almost as silent and lifeless as an ice-cube. But, deep inside it, these 400-foot long missile-detection antennas will guard the life of our country.



They're part of a Ballistic Missile Early Warning System (BMEWS). Officially, you'd call them surveillance radar antennas. Yet, they look like over-sized baseball mitts. That web-like framework can detect (or spot) a far-off missile darting through the shivering Arctic sky, and rifle its speed and direction to any of our military bases in seconds.

Up here, weather is a constant battle. Arctic storms slam into the 163-foot high antennas, and rake icy fingers back and forth over the mesh-faced structures. But they'll stand for years. The D. S. Kennedy Company, builders, made certain of that by weaving foot after foot of USS National Seamless Mechanical Tubing into every antenna.

USS National Seamless Mechanical Tubing is an ideal load-carrying member, because it resists bending stresses in all directions and gives you a superior cross section. It absorbs and localizes shock. And for a given size and weight, the tubular form withstands more load than other sections.

USS National Seamless Mechanical Tubing also fabricates easily into parts. It's stocked by National Tube Distributors all over the country. They will gladly show you how to use USS National Mechanical Tubing in your next application. *See your National Tube Distributor.*

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CUSHIONCRAFT is steadied after it develops lift with its air cushion. Port propulsion rotor is pitch-controlled and is fully reversible.

two passengers and some outside cargo. Designed to operate at an altitude of 12-15 in., the vehicle is built of wood and uses a mass-produced sports car engine and transmission.

Total outlay so far amounts to about $28,000, but similar versions of this size could be sold for half this figure. Cost of larger vehicles up to 10 tons would work out, Norman estimates, at about $5 per lb. empty weight, or about the cost per pound empty weight of light aircraft. Weight to horsepower ratio of production vehicles would not exceed best automotive ratings.

Annular Impeller

Low cost of the Britten-Norman hovercraft springs largely from use of an annular impeller rotating over the peripheral nozzle of the craft. The arrangement eliminates ducting and hence the need for a multiskinned vehicle. This simplifies the strutcure, enables use of a wooden structure and halves the weight. It also improves aerodynamic lift characteristics. Use of automotive parts makes another major contribution to the low price.

Rotor dynamics, however, are likely to put a fairly low practical size limitation on the craft. In large craft the rotor system may be duplicated, which would also enable the retention of mass produced automotive units.

Design Innovations

The Britten-Norman hovercraft uses an annular air jet around the periphery of the craft to maintain the cushion in exactly the same manner as is employed in the Cockerell N-1 hovercraft. Likewise the jet curtain is directed inward and then deflected outward by the pressure in the cushion. Rate of change of curtain momentum due to the deflection represents a force which theoretically exactly balances cushion pressure. Consequently the cushion is contained statically, relative to the craft, by the air curtain, the base of the craft and the land or sea surface over which it operates. All the air delivered to the jet is lost and this energy absorbs about half the total horsepower installed, the other half being used for forward propulsion. No air is lost from the cushion.

Lift System

Britten-Norman vehicle has maintained the Cockerell lift system but uses a different method of generating the cushion. Instead of using a centrally mounted ducted fan coaxial with the engine to duct high velocity air radially out to the peripheral jet, the cushioncraft uses a shrouded annular rotor with the same diameter as the jet and coaxial, thereby discharging directly downward into the nozzle.

Aerodynamically, Norman told AVIATION WEEK, the relative behavior of these two compressor systems is roughly analagous to wing aspect ratio in the case of aircraft. By moving a large mass of air at a lower velocity than the hovercraft, it derives the same air reaction advantages as do aircraft with higher aspect ratios.

Spray Effects

Besides being more efficient, the ground erosion or spray effects caused by the curtain are decreased considerably.

The actual jet velocity in the cushioncraft of 50 fps. is only about one third that of the hovercraft.

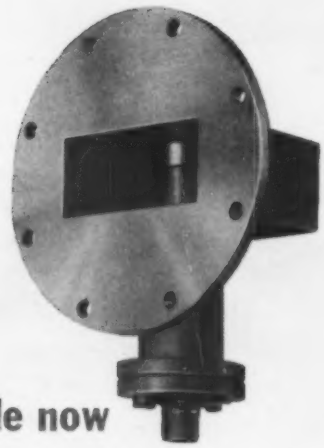
Locating the annular shrouded rotor—it has 40 aerofoil blades, 25 deg. pitch, and is about one foot long—over the jet outlet eliminates ducting and hence the multi-skin construction needed in the hovercraft. Absence of ducting and the resulting ability with the configuration to use spruce and plywood construction has reduced specific structural weight characteristics, and lowered cost several times. There is also the advantage of reduced duct losses.

The proportion of lift provided by the cushion, which is directly related to the cushion pressure, is also reduced. Whereas in the hovercraft the cushion develops virtually all the lift, in the Britten-Norman craft it takes two thirds of the weight. The remainder is developed about equally by the vertical component of the initial jet curtain thrust and the aerodynamic lift

First View of Enlarged Bell Iroquois Mockup

First view of new Bell YHU-1D Iroquois turbine-powered helicopter, now under development, shows full-scale mockup (minus rotor blades) recently inspected by a group of military personnel attending a development engineering inspection at Bell Helicopter Corp.'s Hurst, Tex., plant (AW June 27, p. 35). YHU-1D has a larger cabin than previous HU-1 versions, with capability for carrying 12 fully-equipped soldiers, a 50% increase in capacity.

SMALL APPETITE NOISE SOURCES



service-proved and available now

Until recently signal simulators for monitoring radar receivers or microwave relays were of two types. One was a big and heavy ampere eater with cumbersome auxiliary equipment; and the other was a sensitive though delicate instrument suitable only for the laboratory.

We call your attention now to the Litton 2000 series of miniature gas noise sources. The Litton 2000 for waveguide use is pictured above. It has a first cousin, the Litton 2007 designed for coaxial cable use. We call your attention because most tubes in this series are now in production and we suspect there are frustrated design engineers who will receive this announcement with keen interest.

Our gas noise sources may properly be called miniature. They require only inches of space, smaller, lighter auxiliary equipment, and small voltages and currents. Around 500 volts fires them; 100 milliamperes maintains them. These characteristics, plus others, have caused them to find numerous applications: for in-flight calibration and test of aircraft microwave receivers; as *automatic* watchdogs on airborne radar systems; and in other systems which require various immunities to vibration, shock, humidity, and temperature cycling.

The Litton family of miniature gas noise sources, like all Electron Tube Division products, was designed to solve specific end item functions. We have found that this philosophy contributes to consistent reliability: tubes do their jobs more efficiently, for longer periods of time, and at lower overall cost to the buyer. Other advantages also result. For example, these noise sources require *no* ageing-in and the L-2000 is replaceable in the field without changing the mount.

Specific frequency ranges in L, S, C, X and K bands are covered. If you are concerned with radar transmission, or with microwave data links of any kind, we'll gladly send you more information. Write to Litton Industries Electron Tube Division, Office A15, 960 Industrial Road, San Carlos, Calif.

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CAPABILITY THAT CAN CHANGE YOUR PLANNING

Commercial Hovercraft

London—A 25-ton hovercraft—the SRN-2 is being constructed in the Isle of Wight by Hovercraft Development, Ltd., and Westland Aircraft (Saunders-Roe Division). Design speed of the SRN-2 is 70 kt. and the enclosed cabin will accommodate 68 passengers (AW Sept. 14, 1959, p. 30).

SRN-2 will be powered by four free-turbine engines, probably the Blackburn Marbore, driving fans for lift and aircraft-type propellers for forward propulsion. The hovercraft is scheduled to be completed by the fall of 1961, which will make it the first entry in the commercial hovercraft field.

developed by the intake air passing over the annular shroud ring of the rotor.

The annular rotor, which has no hub, is located in a circular track by small solid-tire wheels, six being located in each axis for a total of 18 wheels. Driven by a friction wheel, the peripheral velocity of the rotor reaches 240 mph. with centrifugal accelerations of the order of 300g. The designers realize that this method of locating a rotor under these conditions is one of the trickiest details of the configuration, but feel they have already solved the problem. Heat alone could melt ordinary rubber and they have avoided this problem by using solid duthane rubber—based on polyurethane—which has been recently developed.

The two-dimensional airfoils used generate a lift coefficient of 1.2 which Britten is certain can easily be improved. The system is also amenable to a relatively simple, variable pitch control if this is thought necessary. Rotation of the craft is prevented by slotted stators, which remove any tangential components in the jet curtain.

Off the shelf proven high performance transmission consists of a quantity produced Coventry Climax sports car engine and a Rootes MG automotive gear box which together cost less than $900. This installation drives a standard racing car wheel with a Michelin X tire which is loaded vertically and directly on the upper surface of the rotor shroud. During the development program the larger Jaguar automotive engine, using the Gnat aircraft landing wheel as the friction drive wheel, will be used. The Climax four cylinder, gasoline engine is considered the most highly developed automotive engine in Britain and can be cruised continuously at 170 mph. and 4,700 rpm.

A geared shaft drives twin Hiller tail rotors which are driven unidirectionally for propulsion and differentially for maneuvering purposes.

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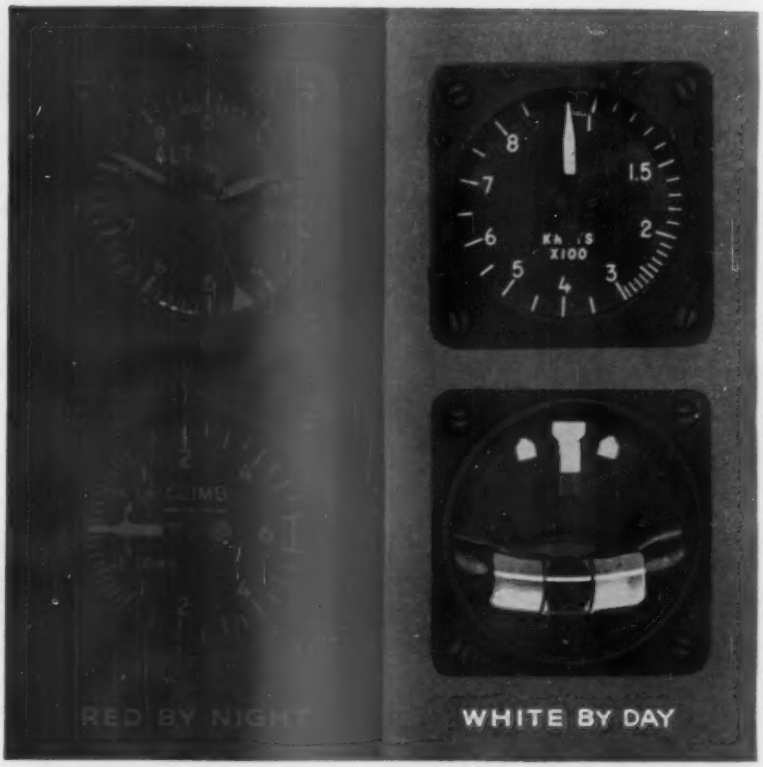

SENSITIVE ALTIMETER
BENDIX TYPE 1587—Extremely accurate 3-pointer altitude indication, in feet. Operated from aircraft's static pressure source. Calibrated pressure-altitude range: −1000 to +60,000 ft. Adjustable ground level pressure reference, from 28.1 to 31.0 inches of Hg. Meets Exhibit WCLCI-1-50(a) (modified for barometric set).

AIR SPEED INDICATOR
BENDIX TYPE 1458—Single-pointer, range 100-850 knots. Diaphragm-operated, through temperature-compensated amplifying linkage, by difference between static pressure of the air through which the plane is flying and the impact pressure created by its forward velocity. Meets Exhibit WCLCI-1-51.

VERTICAL VELOCITY INDICATOR
BENDIX TYPE 1655—Provides indication of aircraft's rate of ascent or descent up to 6000 ft/min. Temperature and altitude compensated. Compensation also provided to reduce errors due to rapid rate of change in temperature of static source. Adjustment provided for zero-setting. Meets MIL-I-18804A (ASG).

TURN AND SLIP INDICATOR
BENDIX TYPE 1738—Provides attitude information to pilot to keep aircraft laterally level and in longitudinally straight flight. Helps establish desired rate of turn and proper bank angle for that rate of turn. Turn indicator incorporates air-driven gyro. Slip indicator is a ball-type inclinometer. Meets MIL-I-8687A.

Easy to read, accurate, dependable

Each of the above instruments is panel-mounted and has a two-inch, direct-reading dial. They are integrally lighted in accordance with MIL-L-25467A—red by night, white by day—by 5 volts AC or DC. Operating temperature range is −55°C to +70°C. Can also be provided with white light.

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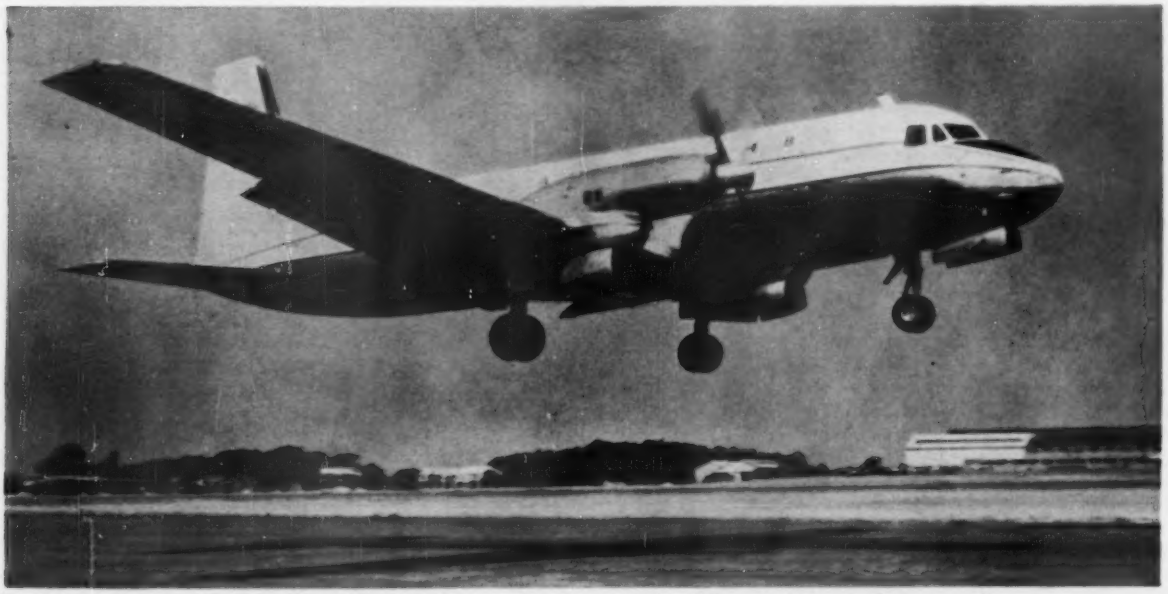
Bendix

Avro 748 turboprop feederliner is shown on its maiden flight from A. V. Roe, Ltd.'s, flight test field at Woodford, England.

Avro 748 Turbine Transport Makes First Flight

Prototype of Avro 748 turboprop feederliner has made its first flight 17 months after A. V. Roe, Ltd., made decision to proceed with the project. Plane sells for about $476,000 (AW Sept. 14, 1959, p. 74) and is powered by two Rolls-Royce Dart Mk. 514 turboprops of 1,740 eshp. each. First flight lasted 2 hr. 45 min. Plane's gross weight is 33,000 lb. Project included construction of a mockup and a second fuselage, used for structural testing in a water tank at Woodford, England (AW Nov. 30, p. 42).



Transport carries 40 passengers at 230 kt. cruise speed. The 748 utilizes Vickers Viscount systems and power pack.

Rotary-Wing Booster Recovery Studied

New York—Controlled recovery of high-thrust rocket boosters and nose cones by means of stored energy rotor systems will be investigated for the Air Force by Kaman Aircraft.

The rotary wing retardation devices, also applicable to the recovery of ejection and space capsules, will be studied by Kaman under a Fiscal 1960 Air Research and Development Command contract totaling $448,000 (AW July 4, p. 39). The rotary wing recovery method is thought superior to folding wing glider and parachute methods in that it permits directionally-controlled descent and a low-impact landing with a minimum weight penalty. However, studies of other retardation methods are under investigation.

Kaman's ARDC contract will consist of two phases, which will be conducted concurrently. The first phase will concern the building and testing of a 196 lb. rotary wing device. This device will be released from aircraft at high subsonic speed (600 kt.) at altitudes to 50,000 ft. This will provide investigation of high subsonic deployment, retardation, guided control of descent to a preselected landing site and flare-out landings with near zero velocity in both horizontal and vertical directions.

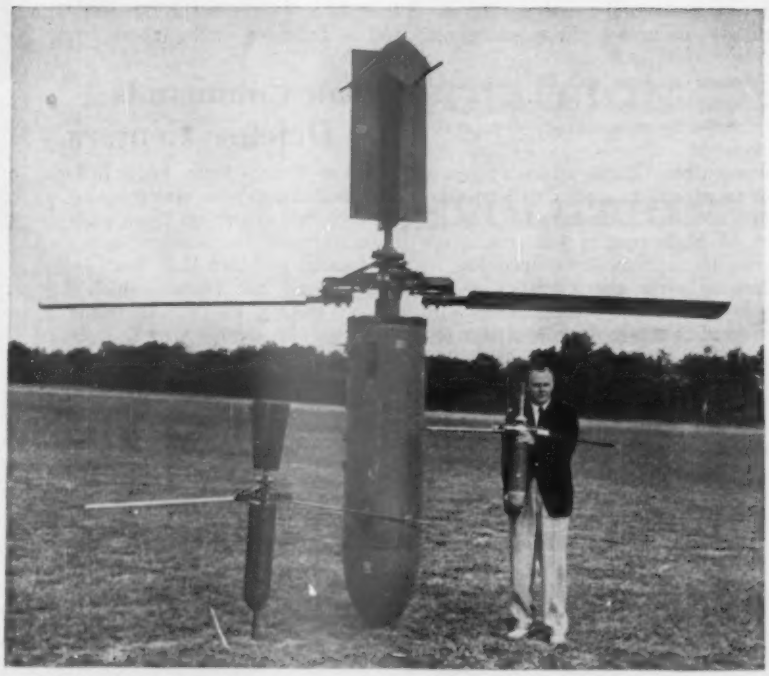
The second phase of the contract calls for a study to determine the feasibility of recovering large packages at hypersonic speeds from high altitudes.

The helicopter company considers the rotating recovery system a natural extension of two earlier programs, the Rotochute air delivery package and its drone helicopter guidance project. The Rotochute, developed for the Navy and Marine Corps, delivered payloads from 6 to 900 lb. with both fixed-length and telescoping blades from 1 to 24 ft. in diameter. The Rotochute, although successful in tests, was never placed in production.

The company's drone helicopter, a Kaman HTK-1, demonstrated controlled hovering and cruising flights in 1952. The project was conducted under Office of Naval Research contract.

Subsonic Tests

The subsonic rotary wing recovery tests will employ a modified KRC-4 Rotochute. The 196 lb. package (blades folded back) will be mounted on the bomb rack of a jet aircraft and released at a speed of 600 kt. Upon release, a delayed action squib releases a torsion spring and rotates a cam to force all four blades to pivot and extend out from the body axis. Simultaneously, another squib releases the governor compression spring causing the blades to sweep forward and impart initial rotation to the system. Once the rotor is brought up to speed, the system is free-coning. Directional stability will be provided by a fold-out tail fin.



ROTOCHUTES, high speed air delivery vehicles, will demonstrate effectiveness of controlled recoveries by means of rotary wing retardation devices.

Rotor speed is governed by a large compression spring acting through a lever which retracts or extends the rear points of the blade flapping hinges. This creates a constant speed rotor by changing the collective pitch of the blades. A swashplate, blade pitch bearings and connecting links provide cyclic pitch.

Initial Tests

During initial tests a ground sensor consisting simply of a cable hanging from the nose of the Rotochute will initiate flare-out sequence.

The flare sequence begins by moving the swashplate (by electrical jackscrew) to the full aft cyclic position and limiting the governor spring to increase rotor rpm. After a preset time interval, the longitudinal cyclic returns to neutral and the governor spring is compressed to cause the blades to go to increase collective pitch. This should reduce vertical speed of the Rotochute sufficiently to achieve a near-zero speed ground impact.

The control system consists of a d.c. relay servo system in the lateral axis only. Longitudinal axis control is held at a constant angle to permit a predetermined glide slope during controlled flight. "Left-right" control signals are interpreted into command signals to introduce lateral cyclic control to the blades. The data link is a two-way pulse amplitude modulation-FM system.

Test Drops

Approximately 25 drops will be made with the Rotochute under varying conditions. The first five drops, to test the opening, descending and landing sequences, and the following 10, to test cyclic control, will be made at speeds no greater than 200 kt. and altitudes to 5,000 ft. This will permit testing at Kaman's Bloomfield, Conn. facility. The last 10 drops, utilizing full guidance and controls, will be made at higher altitudes at speeds to 600 kt. and will require a military test range with radar facilities.

Phase two of the rotary wing recovery study will attempt to define the optimum conditions and ultimate applications for the concept.

This feasibility study will include: facilities.

- **Studies to determine supersonic** and hypersonic aerodynamic characteristics of various blade sections, missile body configurations.
- **Parametric performance** surveys to determine the relationships between rotor

and vehicle configurations. Optimum number of blades, vehicle velocity versus rotor rpm., vehicle size versus velocities and trajectories and aerodynamic, mechanical and aeroelastic requirements will be investigated.

• **Dynamic analysis** will be performed to determine governor requirements for a selected range of payloads and rotor requirements.

• **Aerodynamic heating effects** at hypersonic speeds will be studied to determine blade structural requirements, possibility of blade cooling and system requirements for hypersonic operation.

• **Opening cycle characteristics** of selected payloads and configurations will be studied in effort to reduce peak accelerations.

• **Governor requirements** for transition from hypersonic to subsonic flight conditions will be studied.

• **Several selected vehicle parameters** will be investigated to show height and velocity of deployment, estimated gross weight and components weight of the vehicles, rates of descent obtainable, requirements for cooling and the necessity for special metallurgical techniques. Stability requirement, governor characteristics and flare-out techniques also will be indicated in the report.

Japan Commands Air Defense Centers

Tokyo—United States forces in Japan are scheduled to turn over three air defense control centers to Japan's self defense air forces this month. The centers are located on three U. S. bases—Johnson, Misawa and Itazuki—which were granted to U. S. forces under the U. S.-Japan mutual security pact just revised and which has been the center of a political crisis. Last year the U. S. turned over 26 radar stations to the Japanese and the air defense control centers are the next step in the process of readying the Japanese to take over their own air defense. The centers have been jointly manned by Japanese and U. S. personnel for some time.

Missile Component Uses Chemical Milling

Technique called Chem Size, developed by Anadite, Inc., Los Angeles, Calif., can bring low quality steel and other metals previously thought unfit for aircraft and missile use to close tolerances at a specific gage. Above is stainless steel dome (4335 AMS steel) for a missile fuel tank which was brought to a tolerance of .248 in. through chemical milling which eliminated surface pits.

MOTOROLA

EVOLUTION & REVOLUTION

REVOLUTION in electronics may have its genesis in the *evolution* and synthesis of four prime areas: the rapidly maturing technologies of semiconductor development and production, surface passivation and stabilization research, electronic ceramic engineering and controlled thin film deposition. Synthesis of effort in many scientific and engineering disciplines is required to achieve breakthroughs in these areas and accelerate the evolution from conventional to microelectronic circuitry. The Solid State Electronics Department of Motorola's Military Electronics Division is exploiting this approach as the key to long life and reliable performance of electronic equipment by eliminating excessive complexity in component interconnection.

RELIABILITY improvement demands a reduction in the number of point-to-point connections used in equipment design. Highly specialized engineers, physicists and chemists, at Motorola, are making significant contributions to the new art of non-topological integrated circuitry. All well-qualified scientists and technicians seeking professional growth will find stimulation and challenge in the Motorola Solid State Laboratories.

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Bendix PRODUCTS DIVISION South Bend, IND.

Lockheed Develops New Escape Capsule

Lockheed Aircraft Corp. has developed an aircraft escape capsule under study contracts for USAF's Wright Air Development Division which is calculated to combat severe environmental effects up to 100,000 ft. altitude. The capsule, projected for airplanes in the 1963-65 era, will be built principally of titanium.

Lockheed's concept is to make the entire cockpit into a separate capsule that could be parachuted safely onto any surface, including water, would be able to float indefinitely, and would contain an emergency radio and survival items such as parkas and fishhooks. An oxygen supply would be provided. For escape at up to altitudes of 100,000 ft., the following events would occur automatically when the ejection button was pushed:

- **Three wedge-shaped stabilizers** extend from the capsule section.
- **A separation rocket,** burning for ½ sec., would thrust the entire section upward and forward of the aircraft.
- **A parachute would deploy** for final descent at about 15,000 ft., after the high drag stabilizers slow the capsule.

The wedge-like fins are designed to enable the capsule to have arrow-like stability during its free fall.

High speed separation could be accomplished on or near the ground as well as at high altitudes, since the capsule gains sufficient altitude boost from the rocket catapult before the parachute opens to lower the capsule to earth.

The basic escape system was designed around the F-104 for maximum functional realism, according to Lockheed.

British Army Confirms Order for 36 DH Beavers

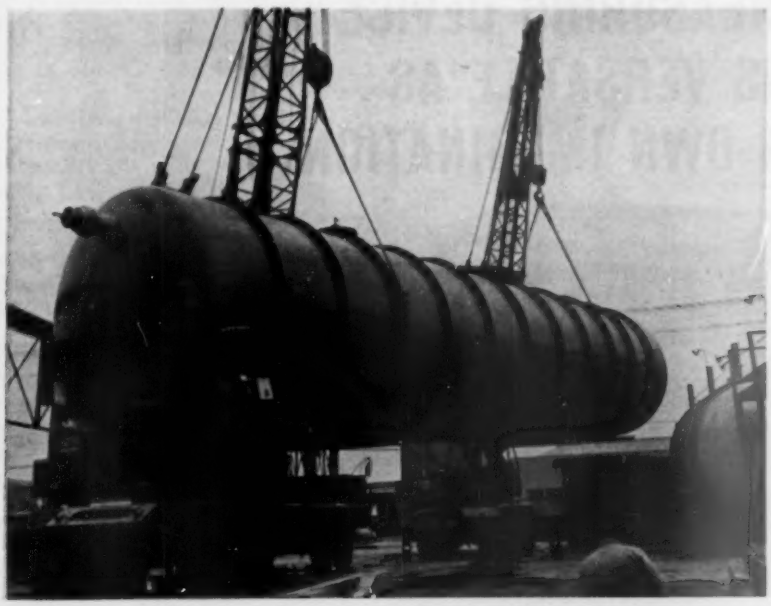
British Army Air Corps order for 36 Canadian de Havilland Beaver aircraft has been made formal. Main components will be manufactured by Canadian de Havilland, shipped to England and assembled at de Havilland's Chester factory.

First deliveries are slated for late 1960 and the contract should be completed during 1961.

Australia Evaluating U.S., Foreign Aircraft

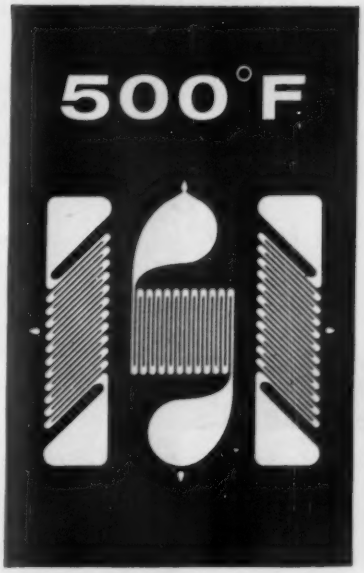
Six-man Australian team is concluding a five-country investigation of new equipment for possible integration into Australia's aerial defense forces with visits to U.S. aircraft manufacturers. The team began a 16-day evaluation of the F-104 Starfighter at Lockheed's California Division last month.

In addition to visiting English, French and U.S. aircraft manufacturing firms, the Australians discussed their requirements with West German and Swiss officials.



Liquid Oxygen Tank Built for Atlas Complex

Cranes move this 28,000-gal. liquid oxygen storage tank from test pad to rail car at Standard Steel Corp. plant in Los Angeles, Calif. Vessel will be installed at Fairchild AFB, Wash., liquid oxygen-producing facility which will serve the operational Atlas missile launching complex now under constructon.



New Tatnall Metal Film 102 higher-temperature backed strain gages from Budd

- Operating range to over 500°F.
- Precision-designed and constructed for exceptional accuracy, repeatability and ruggedness.
- Ultra-thin (less than 0.0015 in.), with no integral leads, for high flexibility and conformability.
- High uniformity in both geometry and temperature coefficient for automatic matching.
- Wide range of sizes and configurations available, including rosette configuration shown above, standard and miniature types.

Call or write for full information.

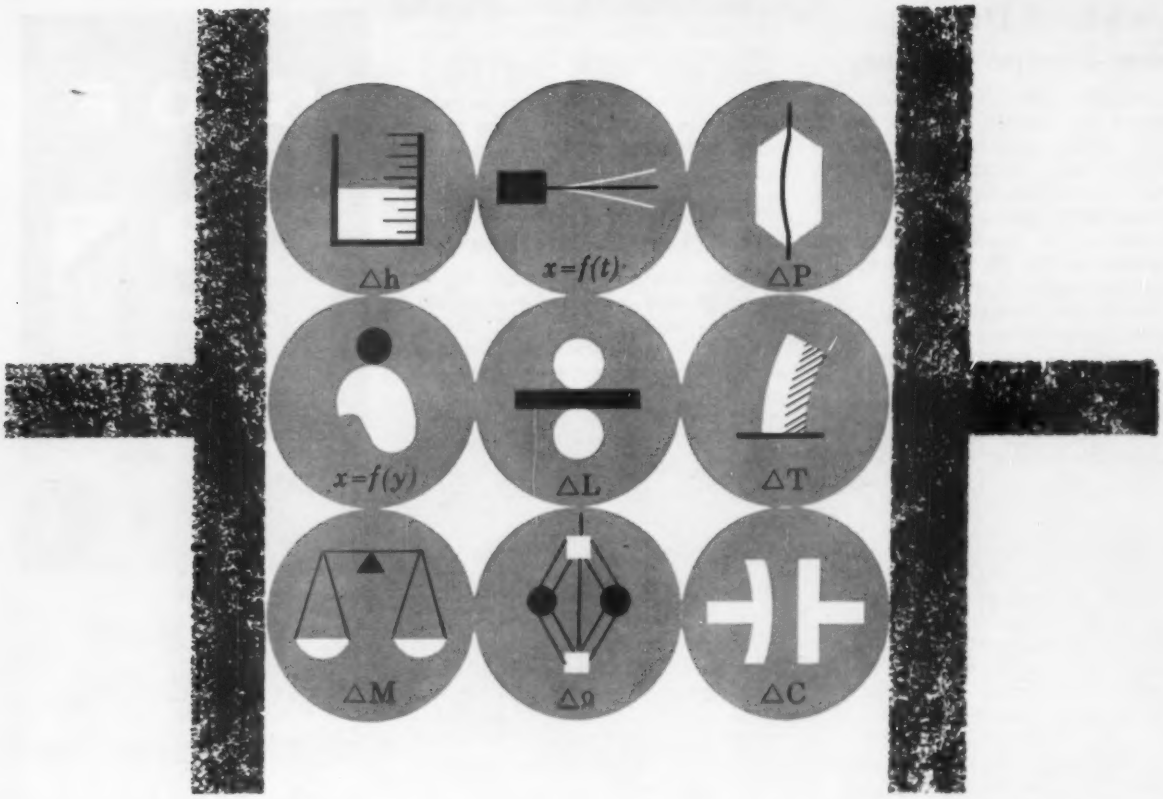
INSTRUMENTS Budd DIVISION

P.O. Box 245 • Phoenixville, Pa.

Consult your phone book for sales offices in: Atlanta, Ga., Oak Park, Ill., Dallas, Tex., Los Angeles, Calif., San Francisco, Calif.

In Canada Tatnall Measuring and Nuclear Systems, Ltd., 46 Hollinger Rd., Toronto 16, Ont.

In Europe BUFRA, 10 Avenue de la Grande Armée, Paris 17e, France.



A MEASURING DEVICE AS VERSATILE AS YOUR OWN IMAGINATION

This one instrument lets you measure—without contact—*any* variable you can convert to a change in capacitance. And lets you do it more accurately and at less cost than has ever before been possible.

Decker's new Delta Unit 904-1 accepts capacitance changes as small as 1 mmf, responds with analog output voltages as large as 30 Vdc which indicate direction as well as magnitude of change.

You simply plug the unit into a 60 cy. 115 v. supply and connect the probe to any simply constructed capacitance sensor that suits your special needs. Everything else you need is built right in . . . including an easily read meter that may be bypassed if necessary to facilitate external recording, display, or control.

A NEW INSTRUMENT BASED ON THE PATENTED DECKER T-42 IONIZATION TRANSDUCER

You'll have no trouble finding jobs for your Delta Unit. The device is so basic that it hardly *has* any limitations. Complete details are on Data Sheet 904-1, available on request. The Decker Corporation, Bala Cynwyd, Pennsylvania.

THE DECKER CORPORATION *Bala Cynwyd, Pennsylvania*

WHAT'S NEW

Reports Available

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.:

High Energy Rate Metal Forming—Report No. 5—by A. F. Watts and G. N. Rardin, Lockheed Corp. for Air Materiel Command, USAF. Apr. 1-June 30, 1959. $4.00; 267 pp. (PB 161274)

Heat Treatment of High-Strength Steels for Airframe Applications—by R. J. Fiorentino, D. B. Roach and A. M. Hall, Defense Metals Information Center, Battelle Memorial Institute, for Department of Defense. November, 1959. $2.50; 111 pp. (PB 151076)

A Review of the Air Force Materials Research and Development Program—H. H. Maxwell, Materials Laboratory, Wright Air Development Division, USAF. November, 1959. $3.00; 169 pp. (PB 111648)

Research Program on High Vacuum Friction: Final Report—Litton Industries of Calif. for Air Research and Development Command, USAF. March, 1959. $3.00; 160 pp. (PB 161116)

Standard for Cemented Carbide Products Proposed—Available without charge from the Commodity Standards Division, U. S. Department of Commerce. (While supply lasts.) (SP-4652)

Subject Index to Unclassified ASTIA Documents—Army Services Technical Information Agency. $30.00—9 volumes; 2,647 pp. (PB 151567)

Armed Services Technical Information Agency—Office of Technical Services Correlation Index of Technical Reports. $3.00 (PB 151567S)

Determining Air Reactions on Moving Vehicles—Part 3: Methods of Hydrodynamics—by M. Z. Krzywoblocki, University of Chicago, for Wright Air Development Division, U. S. Air Force. July, 1959. $3.50; 217 pp. (PB 161141)

High Speed, Electromechanical Goggle—Wayne-George Corp., Wright Air Development Division, USAF. May, 1959. $.75; 29 pp. (PB 151924)

Fundamental Investigations of Electrical Power Sources—Vol. II—by E. J. Hellund, Ph.D., Plasmadyne Corp. for U. S. Air Force. April, 1959. $2.25; 97 pp. (PB 161262)

Not a worry in the world...

WITH THESE TOOLS SNAP-IN CONTACTS ARE A SNAP!

Deutsch-designed for your peace of mind—these special tools, for crimping (manual or automatic), inserting and removing the contacts in Deutsch DS miniature connectors, are simple to use, foolproof, fast and reliable—even in the hands of unskilled operators. The Deutsch eight-indent crimp is stronger than AN #18 wire itself.

WHAT'S MORE... our patented mechanism locks the contacts in place so they withstand at least 25-pounds pull... making Deutsch DS miniature connectors completely reliable.

And... just glance at these Deutsch DS connector specs:

- 7 shell sizes, with alternate clocking and insert arrangements
- exclusive Deutsch ball-lock coupling
- superior interfacial seal
- silicone inserts; no shrinkage, bonding or reversion
- temperature range −67° to in excess of 300° F
- seal before electrical contact
- interchangeable with existing Deutsch DM (MS) miniatures and hermetics
- meet all applicable requirements of MIL-C-26482

So why worry? For details on completely reliable snap-in type connectors, contact your local Deutsch representative or write for data file H-7.

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The Deutsch Company
ELECTRONIC COMPONENTS DIVISION
Municipal Airport • Banning, California

Encase the inferno that makes

We've a good mind to do it at

Capable of withstanding many tons of tensile stress per square inch—yet with a wall thickness measured in a minor fraction of an inch . . .

Longer than the average living room—yet machined to tolerances measured to three decimal places . . .

These are some of the standards resulting from the imaginative approaches our scientists and engineers have taken to design, develop and build first- and second-stage rocket cases for Minuteman under subcontract to Thiokol Chemical Corporation.

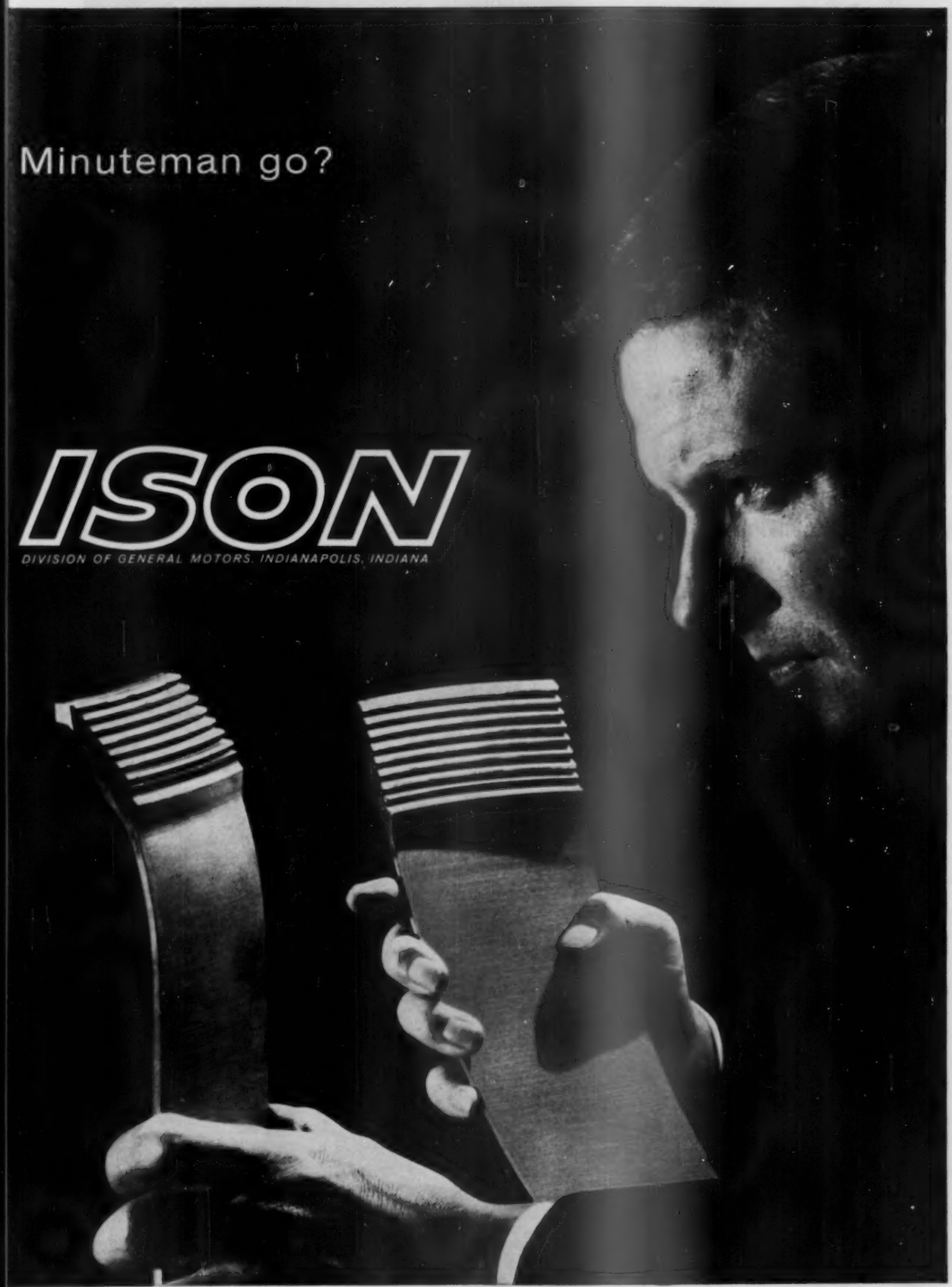
We start with a fundamental knowledge of metals acquired from our advanced metallurgical research programs . . . add our design and processing skills . . . maintain close, positive control from ingot to completed case ready for firing.

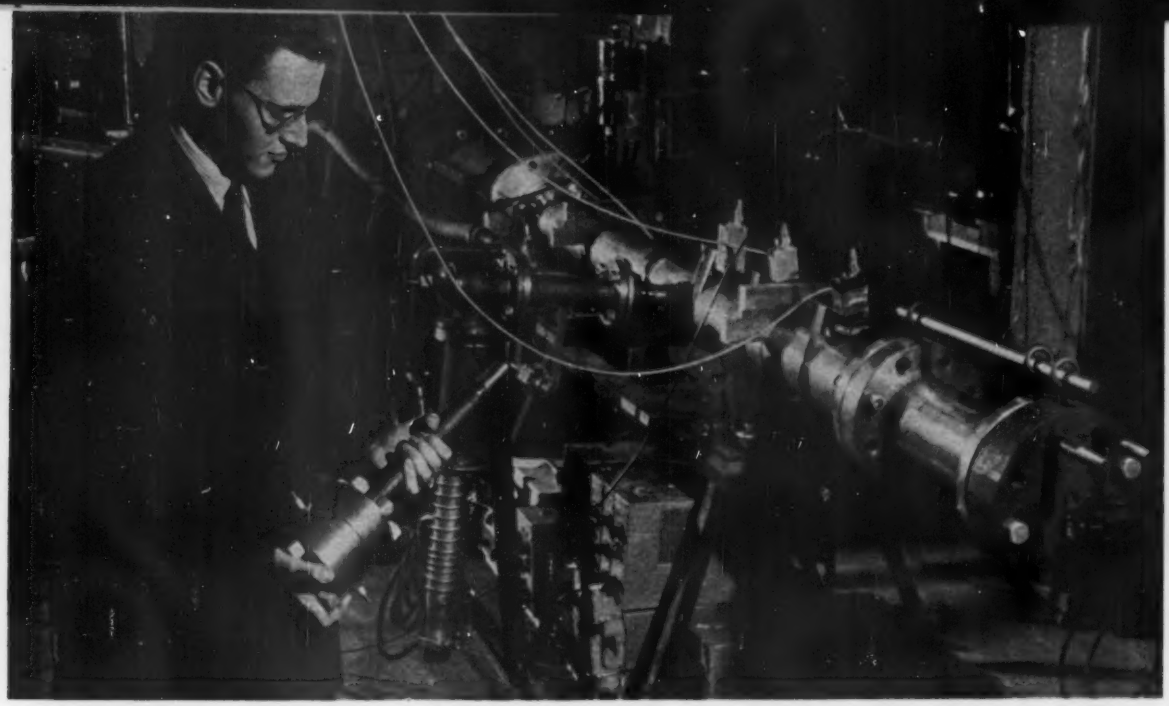
Result? Repeated successful firings of Allison designed and produced flight-weight Minuteman cases—firing-stand proof of the validity of Allison's design philosophy, the soundness of Allison's processing.

And this is but one of the many space-age projects we're putting our minds to at Allison—minds backed by every General Motors resource.

Whether your problem is concerned with the heavens, the earth, or the oceans, Allison has the will and—if it can be solved—the way to solve it. We're doing it for others—we could do it for you.

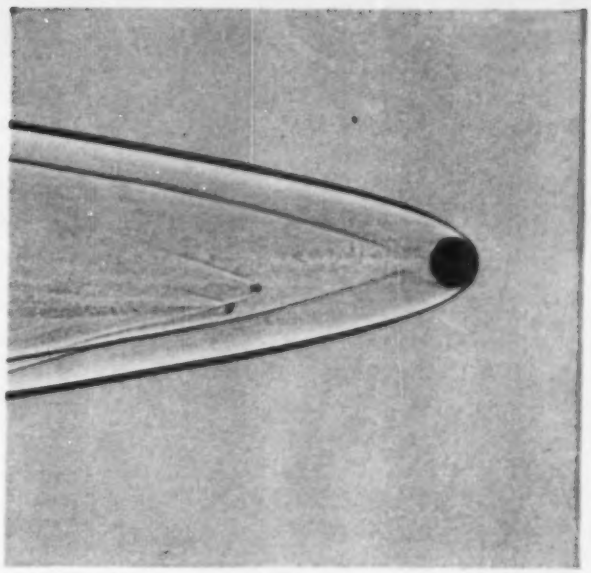
Illustrated is a section of a miniature test case showing a special thread developed by Allison for the aft closure of the full-scale Minuteman rocket motor case.

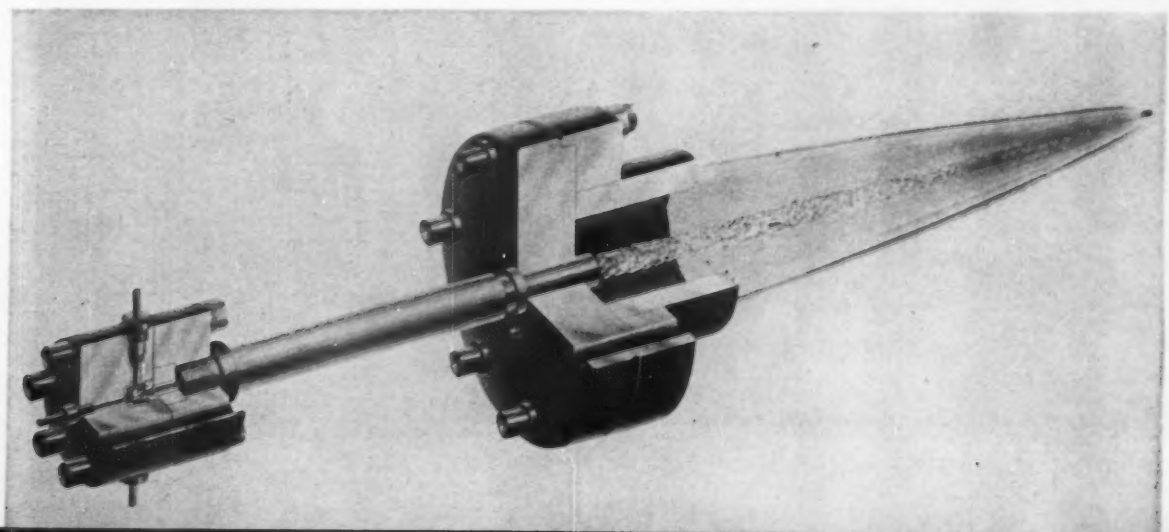

Minuteman go?
ISON
DIVISION OF GENERAL MOTORS, INDIANAPOLIS, INDIANA

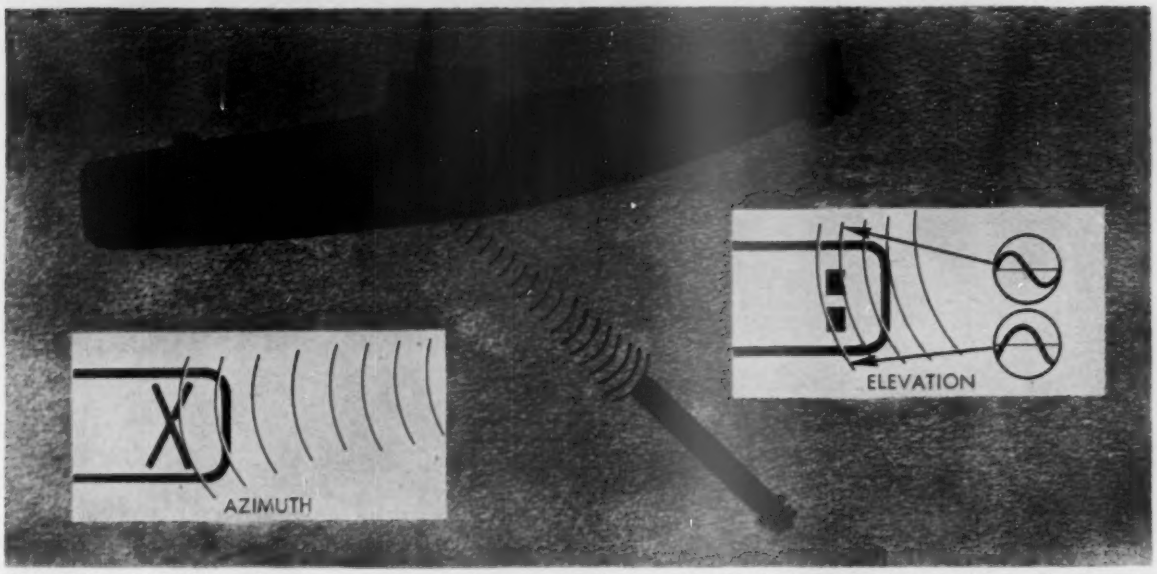


Hypervelocity Gun Propels Projectile At 18,000 fps. for Wake Studies

Hypervelocity generator developed by Avco-Everett (Mass.) Research Laboratory for Army accelerates projectiles to more than 18,000 fps. for studies of wake phenomena as applied to anti-missile and space vehicle re-entry projects. Generator simulates actual velocity, whereas conventional shock tubes simulate heat velocity. Spherical nylon projectiles 0.22 in. in dia. are accelerated by hydrogen pressurized to 120,000 psi. in a driver chamber 2 in. long and 1 in. in dia. Maximum hydrogen temperature is 15,000K. Before firing, the driver section is separated from the 18-in.-long barrel by a diaphragm which ruptures from the force of a 20,000-v. capacitor discharge. Conventional hypervelocity generators use large pistons to heat the driver gas by compression. Dark outline in schlieren photo at right is a shock wave that, in original photo, measured 5 ft. in length. Within the shock wave are two particles which separated from nylon pellet. In top photo, generator's barrel is held by Steven Georgiev, Avco scientist. Window through which schlieren photos are made is at far end of generator.







OPERATION of Mk. 44 transducer group permits simultaneous correction in azimuth and elevation to intercept target. If sonar return strikes one set of transducers more directly than the other, direction will be changed until amplitude is the same. A phase angle difference is produced when the signal strikes one set of transducers before the other, indicating a depth error.

Navy Orders Homing Torpedo Production

Washington—Navy has ordered the General Electric-developed Mk. 44 active homing torpedo into production after a two-year evaluation, and the weapon will be used by the fleet against high performance nuclear submarines.

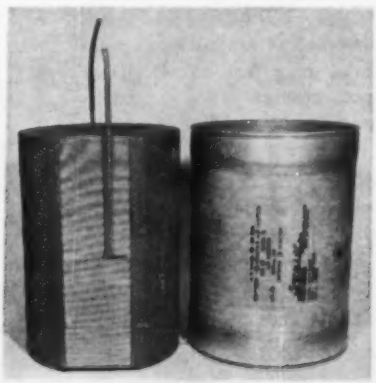
Mk. 44 torpedo is the conventional payload for the Asroc anti-submarine missile system (AW June 27, p. 32). It can also be dropped from attack aircraft and fired from existing surface shipboard torpedo tubes. Mk. 44 has been under development by GE Ordnance Dept. since 1954.

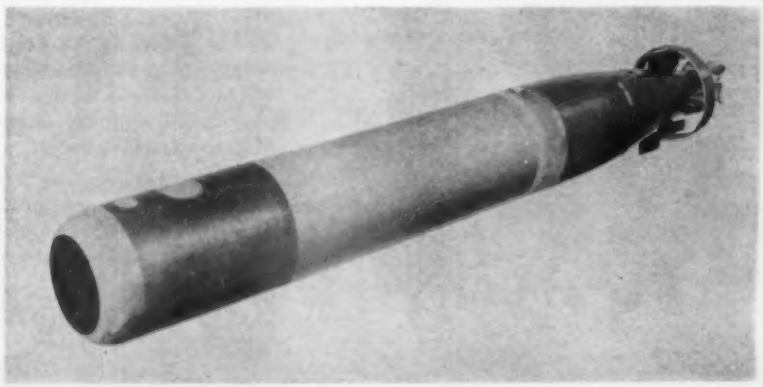
Mk. 44 is 100 in. long and one foot in diameter. Original thermal drive was scrapped in favor of electric propulsion when GE Ordnance developed the high power Mk. 61 salt water battery. Electric power was found to be superior to steam in reliability, power-to-weight ratio and handling ease with the new battery. Silver chloride and magnesium battery plates are dormant until activated by sea water. Storage lifetime is said to be unlimited, with no requirement for recharging.

Active acoustic homer located in the nose section is a miniature low-frequency sonar with sound-to-electric transducer groups. When a target ping is returned, transducers establish azimuth and elevation errors, take the torpedo out of its circling search and aim it on a direct path to the submarine.

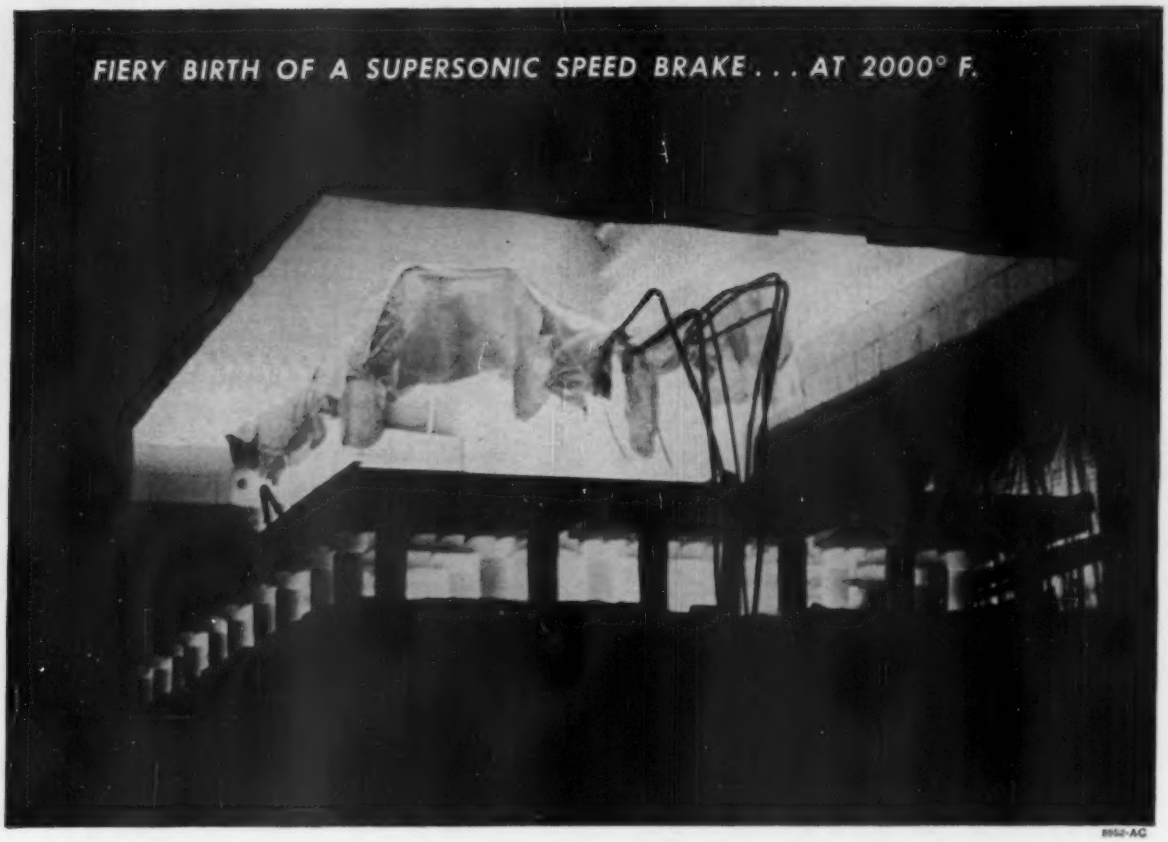
Because Mk. 44 operates at high speed, design of shell, propellers, fins and shroud rings were hydrodynamically integrated to prevent cavitation from jamming the acoustic homer.

Afterbody shell is lightweight aluminum. This metal is more resistant to salt air than magnesium, which also was tested. With aluminum, Mk.





SILVER CHLORIDE and magnesium plates are used in the Mk. 61 sea water battery (at left) to power the Mk. 44 torpedo electric drive. Battery does not require recharging during long storage life. GE says that it has a higher power-to-size ratio than other marine batteries. The Mk. 44 torpedo (right) is 100 in. long and one foot in diameter. Homer and guidance are in the nose section. Warhead is in the center, and the afterbody contains batteries and gear box. Slots in forward section are for nose fairing in Asroc application. Airframe and booster clamp on to the afterbody when the torpedo is rocket-launched.



AERONCA designs, tools, produces and tests advanced brazed honeycomb structures

In the production of exotic high-temperature air weapon components, there is no substitute for actual experience. That is why Aeronca . . . with production records on several thousand brazed stainless steel honeycomb sandwich assemblies . . . is one of the recognized leaders in this highly specialized field.

And to meet the growing requirement for complex high-temperature structures, Aeronca has evolved a fully integrated facility for designing, tooling, producing and testing all types of brazed honeycomb sandwiches. This special facility includes more than 65,000 square feet of plant area and the most advanced production and inspection equipment available today. Brazed structures up to 14′ x 24′ can be produced in volume at present.

Whatever your requirements, Aeronca's experience and capabilities can assure you of uniform quality, on-schedule deliveries and the lowest over-all cost consistent with reliability and performance specifications. Our customers will verify that *Aeronca produces results . . . not claims!*

This complex speed brake for a new air weapon system illustrates Aeronca's advanced capabilities. Photo at top shows one of these units emerging from furnace after brazing cycle (indicated temp.: 2000°F.).

We have openings for creative R&D Engineers with Missile/Space experience. Write to Mr. O. E. Chandler, Mgr. Professional Employment

AERONCA manufacturing corporation
1714 GERMANTOWN ROAD • MIDDLETOWN, OHIO

44 has withstood extreme structural shock of high speed water entry in air drop and Asroc tests.

Mk. 44 torpedo will be produced at the Navy's Forest Park, Ill., ordnance plant, which produces all fleet torpedoes. Current production includes three models of the Mk. 43, the Mk. 37 and the Mk. 15 Mod. 3, as well as the Mk. 44. Mk. 15 is steam driven, is carried only on ships and has no homer. Both the Mk. 43 and Mk. 44 can be launched by aircraft as well as ships. The 20 in. diameter Mk. 37 is launched only from ships and apparently has a nuclear payload.

PRODUCTION BRIEFING

Raytheon Co.'s Missile Systems Division will continue production of the Army Hawk surfact-to-air missile under a $56 million contract. Hawk production will be performed at the division's facilities at Andover, Lowell and Waltham, Mass., Oxnard, Calif. and Bristol, Tenn.

Westinghouse Corp., East Springfield, Mass., will build launching equipment for the Martin Bullpup air-to-surface missile under Navy contract. The contract involves approximately 2,400 launchers.

Chance Vought Aeronautics Division, Dallas, Tex., will develop and test electroluminescent cockpit panels under a $100,000 Bureau of Naval Weapons contract. The electroluminescent panels employ a phosphorescent material sandwiched between two electrical conductors. The material glows when a.c. electrical power is applied. The panels will be flight-tested in Chance Vought F8U aircraft.

The Siegler Corp.'s Hufford Division will produce ground support equipment for the Convair Terrier missile under a $120,000 Navy contract. Production of the components will be accomplished at the division's El Segundo, Calif., facility.

Pratt & Whitney Aircraft Division of United Aircraft will develop new applications for its turbine engines in a newly formed Industrial Power Department. The diversification effort will attempt to tap industrial markets for the sale of gas turbine ground power units.

General Electric's Missile Production Section, Burlington, Vt., will continue production of the Vulcan 20 mm. aircraft cannon under a $2,847,000 contract. The six-barrel cannon serves as armament on the Lockheed F-104, the Republic F-105 and the Convair B-58 tail gun.

IT TOOK 22 YEARS TO PRODUCE THIS INSTRUMENT

You're looking at one of CEC's new high-performance galvanometers

Like all other CEC galvanometers, it's a self-contained, sealed unit that's been made to extremely close tolerances and rigidly tested in more than 30 quality control checks.

But its performance is what makes this instrument unusual. CEC galvanometers offer the ultimate in high-performance characteristics. They're available in 14 types with a wide range of frequency response.

What has all this to do with the fragile, bulky galvanometers of 22 years ago? Plenty. In 1939, CEC research and development created a totally new design concept that has meant technical superiority ever since. For complete information on the best galvanometers made for *your* oscillograph, write today for Bulletin CEC 1528-X2.

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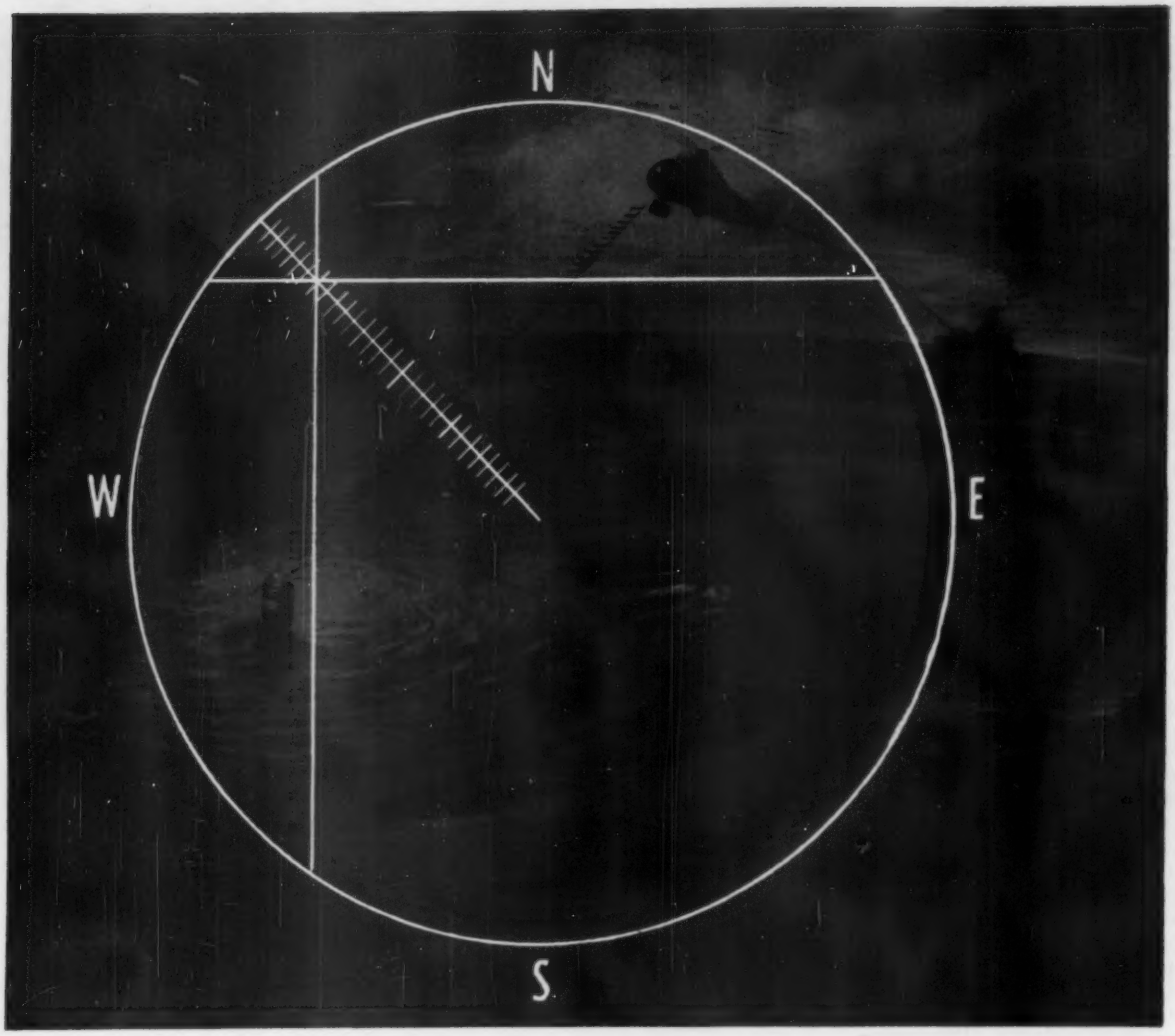

Reporter on the prowl
Norden's Doppler Wind-Distance Computer

In anti-submarine warfare operations, the Navy's Air Arm acts as an aerial eye transmitting target information to surface attack vessels. Norden's compact, lightweight Doppler wind-distance computer presents the pilots with a continuous display of wind velocity and provides accurate information on distance travelled. In the absence of Doppler return, the wind-distance computer continues to provide distance data, based on air speed and computed wind information.

The Norden Doppler wind-distance computer project, successfully developed for the Naval Air Development Center at Johnsville, Pennsylvania, testifies to the company's capability in the airborne analog computer field. And every Norden achievement in the area of advanced electronics is another step toward extending man's capabilities.

• • •

Stimulating positions are available at all levels of responsibility for qualified engineers and scientists.

NORDEN

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UNITED AIRCRAFT CORPORATION
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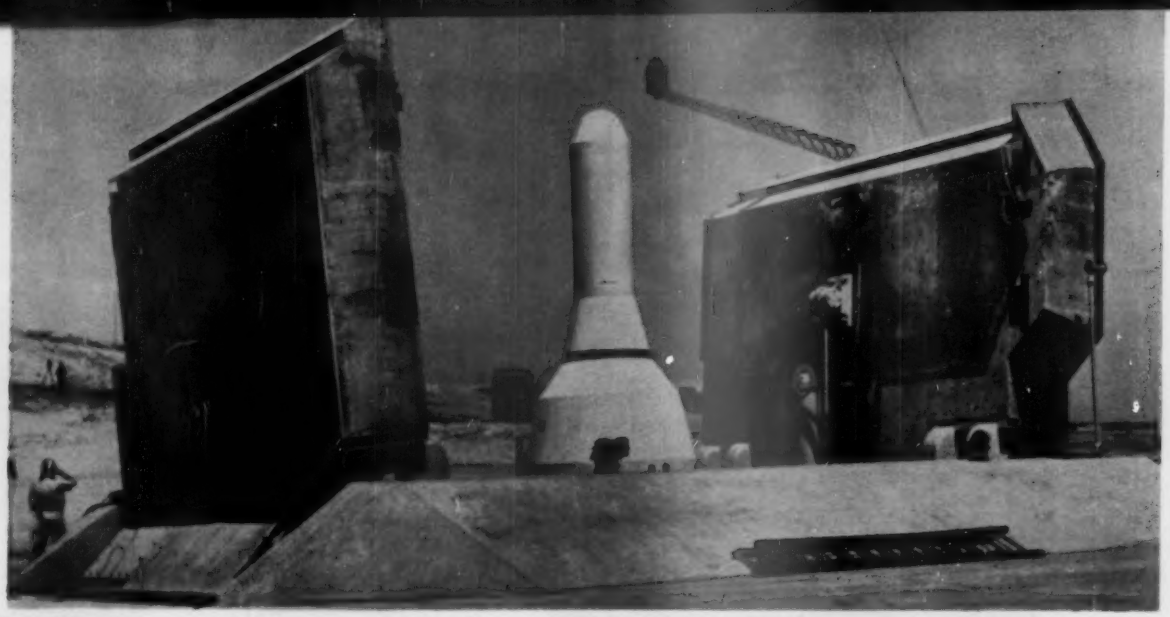
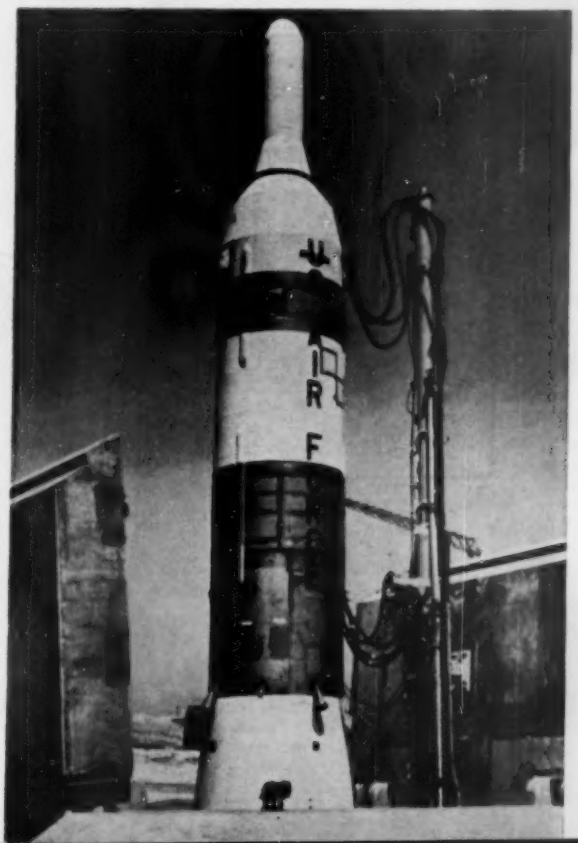
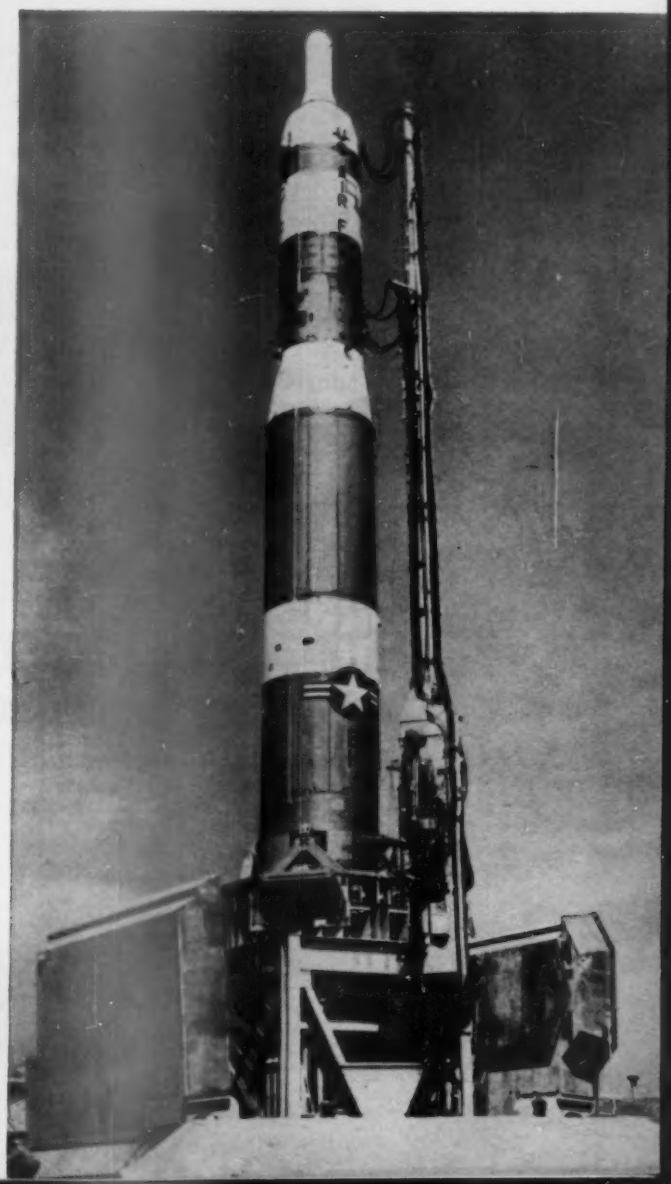


Titan ICBM is seen emerging from underground launcher at Vandenberg AFB, Calif. Steel and concrete doors protect site from attack.

Titan Underground Launcher Prototype Undergoes Tests

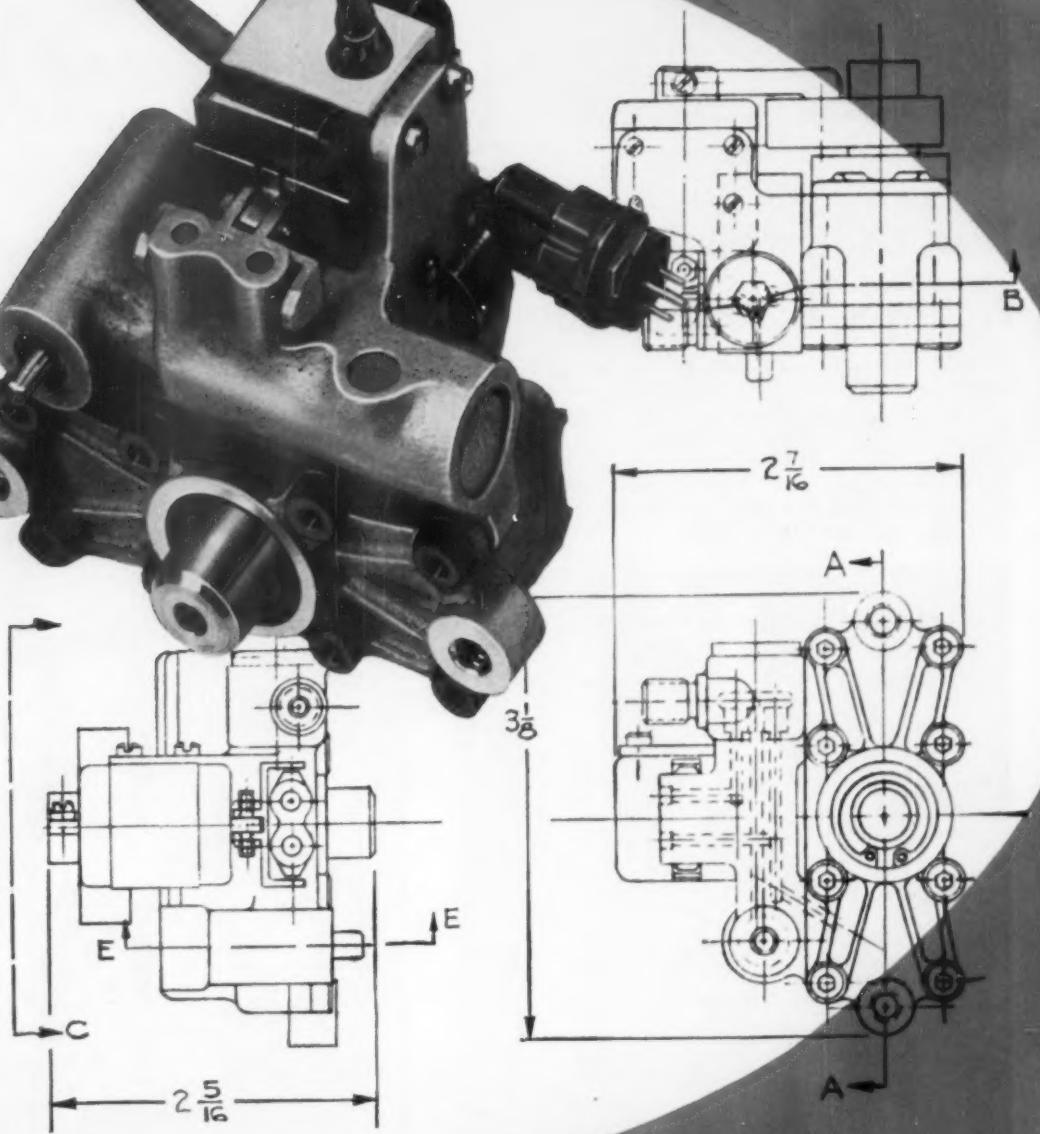
Prototype of an operational underground launcher for the Titan intercontinental ballistic missile is undergoing tests at Vandenberg AFB, Calif., in preparation for first launch from this facility. American Machine & Foundry Co. will build 36 such systems under an $81,567,000 contract (AW July 4, p. 39) and will install them at Ellsworth AFB, S. D.; Mountain Home AFB, Idaho; Larson AFB, Wash., and Beale AFB, Calif. Manufacture will be at Greenwich, Conn., and Buffalo, N. Y.





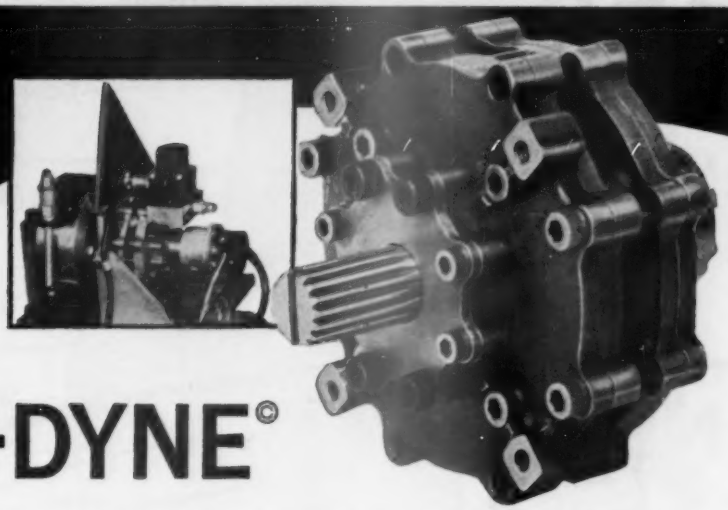
TAPCO POW

1000 in-lbs, ± 15° Rotation Rota-Dyne.
Weight: 21.5 oz. including control valve.



Advanced engineering projects at TAPCO offer excellent career opportunities for qualified engineers and scientists. Write Technical Employment Manager.

ER SYSTEMS



2,000 in-lbs, ± 25° Rotation Rota-Dyne. Inset shows unit on test with closed center valve.

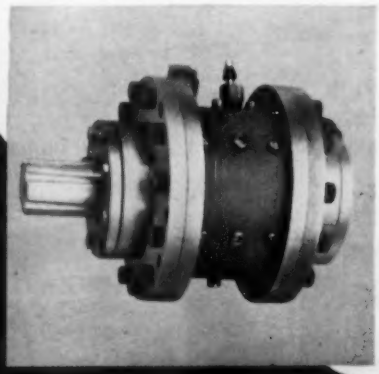
ROTA-DYNE©

Rotary Proportional Hot Gas Servos and Pneumatic Actuators

The Rota-Dyne is a true rotary servo which can modulate angular load position over ranges less than a full revolution. It employs a unique sealing technique which is quite simple, but virtually leak-proof and highly reliable. Developed in a company-sponsored program, Rota-Dyne offers these advantages and design features:

- **Direct drive of fins, nozzles or other loads**
- **Low backlash and internal friction**
- **Close coupling, little structural feedback**
- **Integral gas filters**
- **Low weight to torque ratio**
- **Mechanical position feedback**
- **Frequency response within 3 db to 15 cps**
- **Inlet gas temperatures to 2000°F**
- **Tapco supplied liquid or solid gas generators**
- **Low production costs**

If you would like further information on Rota-Dyne servos, write on your company letterhead. TAPCO Group sales engineers are available for consultation at your convenience.



10,000 in-lbs, ± 8° Rotation Rota-Dyne

TRW

TAPCO GROUP

Thompson Ramo Wooldridge Inc.

Dept. AW-1760, Cleveland 17, Ohio

DESIGNERS AND MANUFACTURERS FOR THE AIRCRAFT, MISSILE AND SPACE, ORDNANCE, ELECTRONIC AND NUCLEAR INDUSTRIES

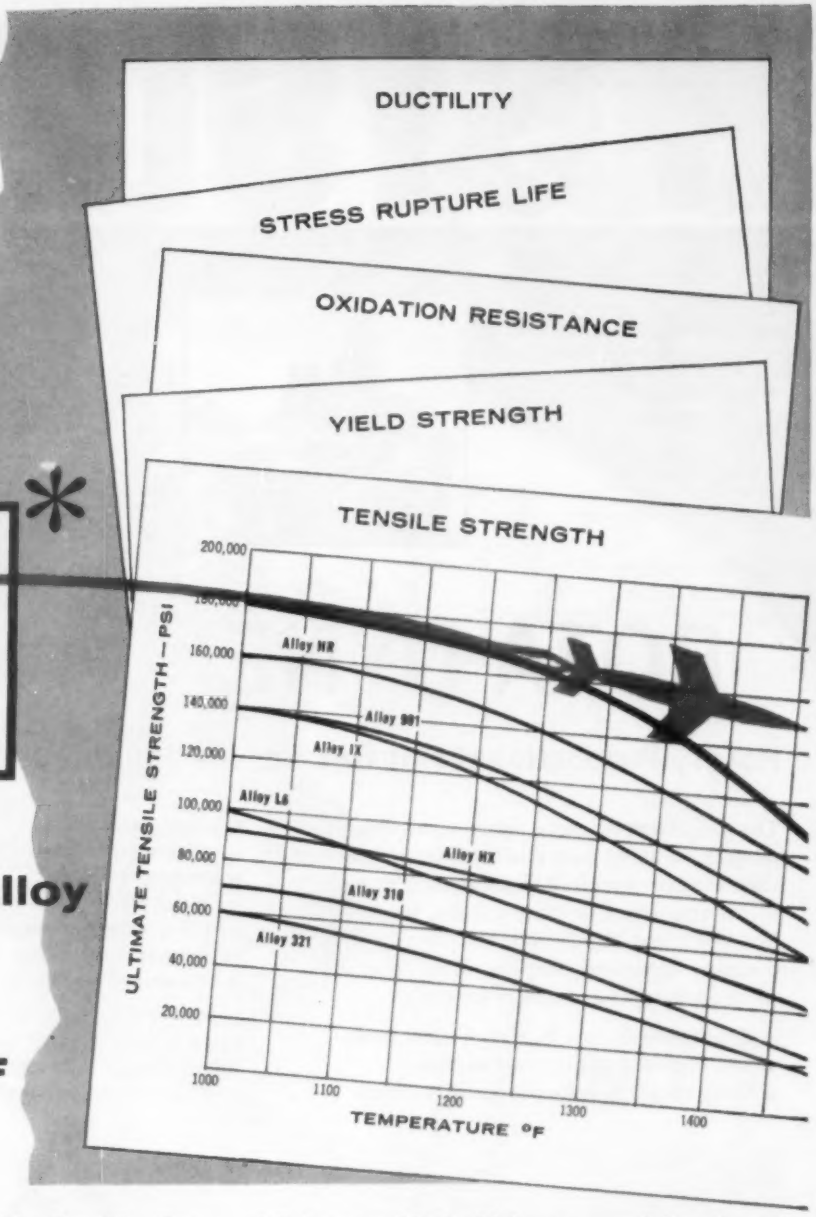
TAPCO GROUP EXPORT REPRESENTATIVE
American Avitron Inc., Mamaroneck, N. Y.

HIGH

on every chart:

RENÉ 41*

most dependable alloy in use today in the 1200°-1800° F range



In *all* ways, René 41 is a remarkable alloy. No other high-temperature alloy used in production today equals its tensile strength. In other properties, too, René 41 is far ahead of the field.

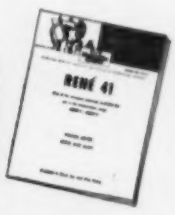
Also important, this nickel-base, vacuum-melted alloy is easy to work with. It's readily formable by drawing, bending, spinning — welds to similar or dissimilar materials.

Cannon-Muskegon offers René 41 in standard 36″x 9″ sheets .015″ to .125″ thick, in smaller sizes down to .010″, in bar stock up to 3″ in diameter . . . foil down to .001 in thickness . . . and fine wire only .0015 in diameter.

For complete details, write for Technical bulletin No. 86.

*TM of General Electric Co.

ULTRA MET
VACUUM ALLOYS



CANNON-MUSKEGON CORPORATION

2879 Lincoln Avenue • Muskegon, Michigan

METALLURGICAL SPECIALISTS

1-59

FINANCIAL

Financial Briefs

Western Air Lines, Inc., one of the few airlines in the U.S. to earn a profit in the first quarter of 1960, has declared a regular quarterly dividend of $0.25 a share, payable Aug. 5. Previous cash dividends were paid on Mar. 4 and May 18, and a 5% stock dividend was distributed on Mar. 23. A Western spokesman said that passenger reaction to Boeing 707 jet service introduced to major Pacific Coast markets on June 1 has been excellent.

Northrop Corp. reported net income of $5,313,000 for the first three quarters of Fiscal 1960, equal to $2.90 per share on 1,830,000 shares outstanding, and based on nine-month sales amounting to $170,466,000. The company's backlog increased by over $60,000,000 in the third quarter to a total of $283,000,000. Expansion resulted primarily from new contracts related to the Polaris missile system and increased emphasis on the guidance system for USAF's Skybolt missile.

Lockheed will reduce its $27 million deferred development costs for its JetStar utility transport by applying a pro rated amount to the purchase cost of five airplanes ordered off-the-shelf by USAF (AW June 27, p. 35). Lockheed deferred the development costs rather than charge them against income last year on the assumption a military order would be forthcoming.

Mergers And Acquisitions

Details of the merger between Airwork, Ltd., and Hunting-Clan Air Transport, Ltd., under the name British United Airways, have been announced (AW Mar. 7, p. 334). The previous owners of Airwork will hold a 60% interest, Hunting-Clan owners the remainder. Group chairman will be M. D. N. Wyatt, chairman of Airwork, and deputy chairman will be Sir Nicholas Cayzer, chairman of the British and Commonwealth Shipping Co., which has a 50% holding in Hunting-Clan. Combined fleet of BU will total 52 fixed-wing aircraft and 54 helicopters, believed to be the world's largest helicopter fleet.

General Mills, Inc., of Minneapolis, Minn., acquired the business of The Daven Co., Livingston, N. J., and Laible Manufacturing Co., Manchester, N. H. Daven supplies high quality

TRAFFIC COP FOR "GO" FUELS
Since they fed the first bird 22 years ago, Grove pressure regulators have set the pace. It is fact that original Grove designs are still the basis for every pressure regulator used in ground support systems today. Specify Grove regulators for dependable pressure control.
GROVE REGULATORS
GROVE VALVE AND REGULATOR COMPANY
A Subsidiary of Walworth
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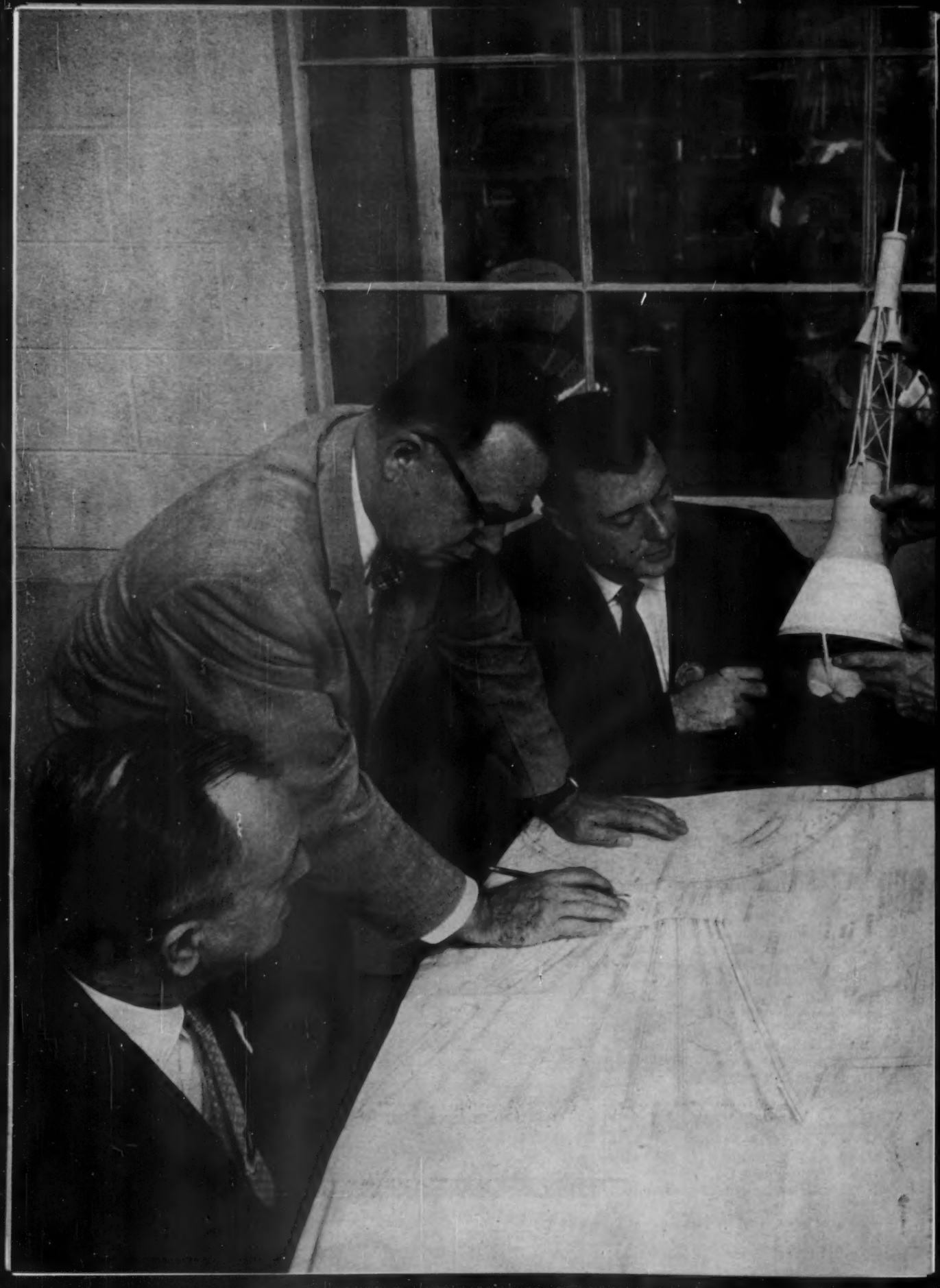

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Ask anyone, anyone you're trying to sell in the aerospace market, what publication he reads and respects most.

A powerful editorial force is a powerful selling force.

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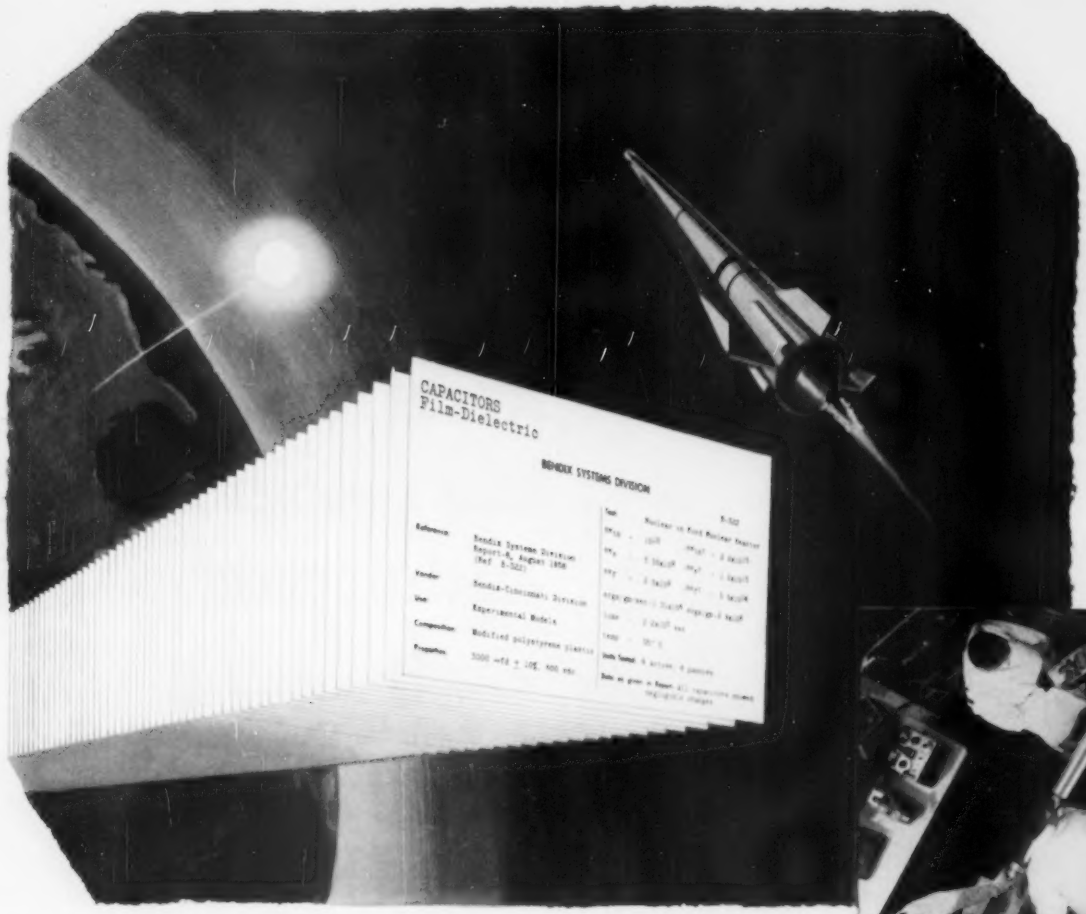


Bendix Engineers use The University of Michigan Reactor to test radiation effects.

SORTE...

summary of radiation-tolerant electronics

Fast neutrons and other nuclear radiations affect the life and performance of electronic systems. Problems of both rate effects and integrated dosage are encountered in the design of advanced military and space systems.

At Bendix Systems Division, we have compiled a comprehensive file which we call SORTE, for Summary of Radiation-Tolerant Electronics. Under Air Force sponsorship, we have exposed electronic components and equipments to nuclear radiation, tested them for radiation damage, and compared performance with control tests made before exposure. Similar tests have been run for improved components submitted by manufacturers. Data from tests and reference sources are arranged on cards to make up the SORTE file. Over 1400 electronic components are already listed.

Based on our test programs and SORTE, Bendix engineers are developing a new approach and methodology to the design of radiation-resistant systems. This approach optimizes the trade-offs between combined environments, component resistance, shielding, size and weight.

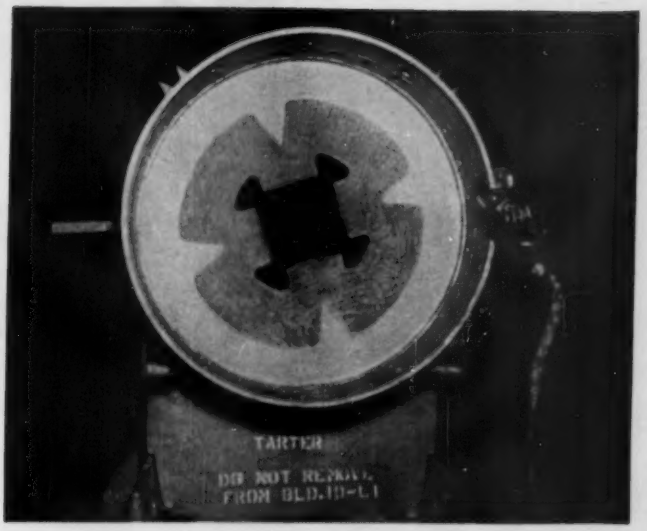
To assist us in this work, and programs such as satellite communications systems, advanced infrared reconnaissance, and the EAGLE air-to-air missile system, we invite inquiries from engineers looking to the future.

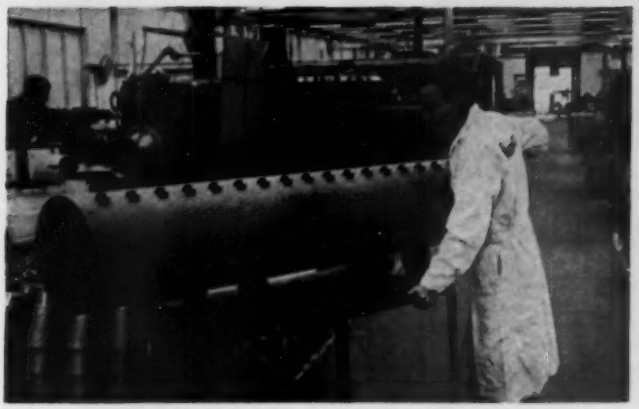
Bendix engineers select data on radiation-tolerant components from SORTE file.

Bendix Systems Division

ANN ARBOR, MICHIGAN

THE Bendix CORPORATION





Aerojet Builds Dual Thrust, Solid Propellant Tartar Motor

Dual thrust, solid propellant rocket motor for Navy-Convair Tartar shipboard anti-aircraft missile (AW Aug. 17, 1959, p. 27), shown at top left, is in production at Aerojet-General's Sacramento, Calif., plant under a $2.5 million contract. Two stage booster and sustainer have been compressed into single unit with one ignition system; after center section booster burns out, the lower thrust, longer duration sustainer (outer section) takes over. Workman (below left) has completed rocket motor casing which will be shipped to the Solid Rocket Plant to be filled with propellant. At right, a completed Tartar is shown on its launcher at Naval Ordnance Test Station. The weapon has been ordered by Japan's Maritime Self Defense Force (AW Apr. 18, p. 23).

components to the electronics industry; Laible manufactures precision wire wound resistors and other subassemblies for The Daven Co.

Onsrud Machine Works, Inc., Niles, Ill., purchased the Hydraulic Press Division of Berthelsen Engineering Works, Inc., Joliet, Ill. Berthelsen products line acquired includes presses for laminating plywood, reconstituted board products, metal, plastics and rubber.

Negotiations are under way between Avien, Inc., and Electrol, Inc., for acquisition of Electrol. Avien is located in Woodside, N. Y., and Electrol is in Kingston, N. Y. Avien, a leading producer of electronic instrumentation systems, recently acquired Colvin Laboratories, East Orange, N. J., and Trident Corp., Boston, Mass. Electrol manufactures precision hydraulic components and systems and is the largest producer of complete landing gear systems for the multi-engine executive aircraft market.

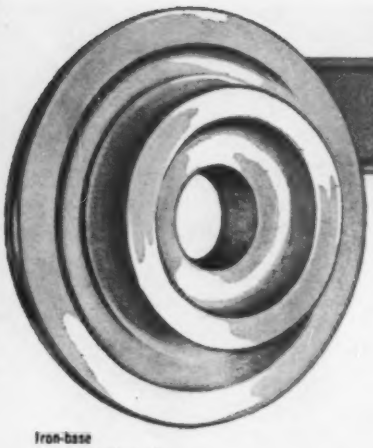
Ampex Corp. and Telemeter Magnetics are considering a merger, based on an exchange of two shares of Telemeter Magnetics for one share of Ampex stock. Ampex would be the surviving company. Negotiations are still in progress, and if completed will then be submitted for approval to the boards of directors and stockholders of both companies.

Cessna Aircraft Co. has completed arrangements for purchase of a 49% interest in the French aircraft firm of Avions Max Holste, Reims, builder of the 23-passenger Super Broussard turboprop (AW Feb. 15, p. 33). Three of Cessna's top executives—Dwane L. Wallace, president; F. A. Boettger, vice president and treasurer, and D. L. Roskam, vice president of aircraft divisions—have been elected directors of the firm.

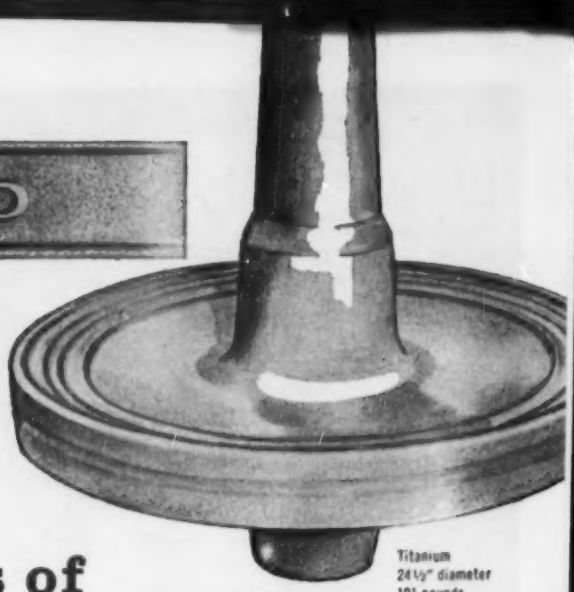
Kawecki Chemical Co., Boyertown, Pa., manufacturer of such compounds as tantalum, columbium and titanium, has purchased a 50% interest in Penn Rare Metals, Inc., Revere, Pa.

Cain and Co., Los Angeles, Calif., electronics sales engineering firm, has acquired Memo, Inc., New York City, an electronics manufacturer's representative.

Directors of Barry Controls, Inc., and The Wright Line, Inc., have voted to merge, subject to stockholder approval. New company will be called the Barry-

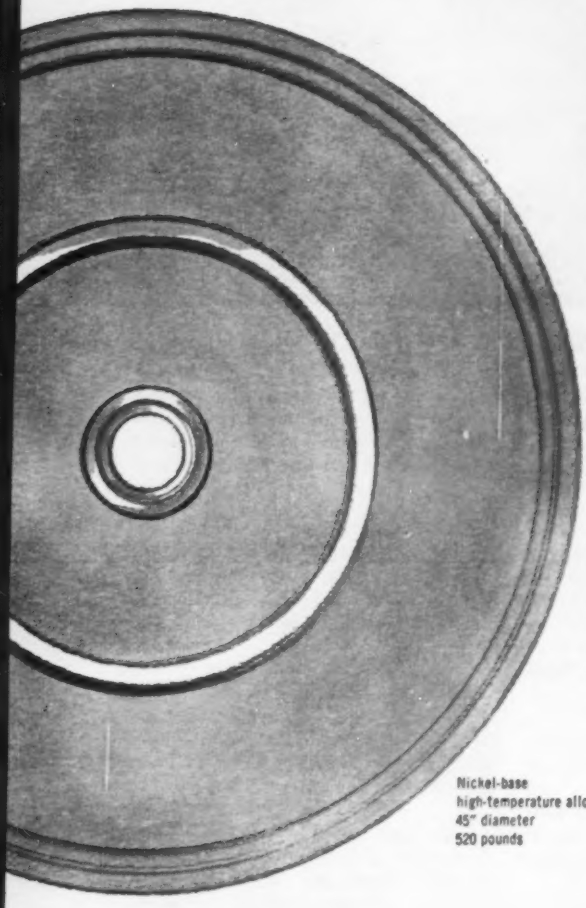


Iron-base
high-temperature alloy
21½" diameter
244 pounds



Titanium
24½" diameter
191 pounds

To speed the progress of gas turbine development



Nickel-base
high-temperature alloy
45" diameter
520 pounds

For applications ranging from automotive to aircraft propulsion, Wyman-Gordon is the world's largest producer of forged components for the gas turbine industry—turbine wheels, compressor discs, blades and vanes, for stationary turbines, nuclear installations, aircraft and missiles.

Wyman-Gordon's production experience includes forgings of a wide range of metals from low-alloy high-strength steels—titanium—intermediate temperature alloys—to the super-nickel-base alloys and refractory metals. *Guaranteed minimum properties* assure improved performance and dependability, and enable designers constantly to raise their sights and increase turbine capabilities.

With unexcelled research and production laboratories to concentrate on your development problems and with hammer and press capacity unequalled in the country, Wyman-Gordon is prepared to serve you in great depth at the design, engineering and purchasing stages of your requirements.

Titanium
15½" length

High-strength steel
19" diameter
143 pounds

EST. 1883

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of Aluminum Magnesium Steel Titanium . . . and Beryllium Molybdenum Columbium and other uncommon materials

HARVEY ILLINOIS · WORCESTER MASSACHUSETTS · DETROIT MICHIGAN

GRAFTON MASSACHUSETTS · LOS ANGELES CALIFORNIA · PALO ALTO CALIFORNIA · FORT WORTH TEXAS

Wright Corp. and R. P. Collins, now president of Wright, will become chairman of the Board; Ervin Pietz, now president of Barry Controls, becomes president and chief executive officer. Barry Controls manufactures shock and vibration equipment for aircraft and missiles and Wright makes accessory and punched card handling equipment for data processing and computer systems.

Lytle Corp., technical communications and electro-mechanical research company, has acquired Allied Research & Engineering Division of Allied Record Mfg. Co., Hollywood, Calif., active in missile components field. Nicholas Sannella, Jr., will manage the new Lytle division.

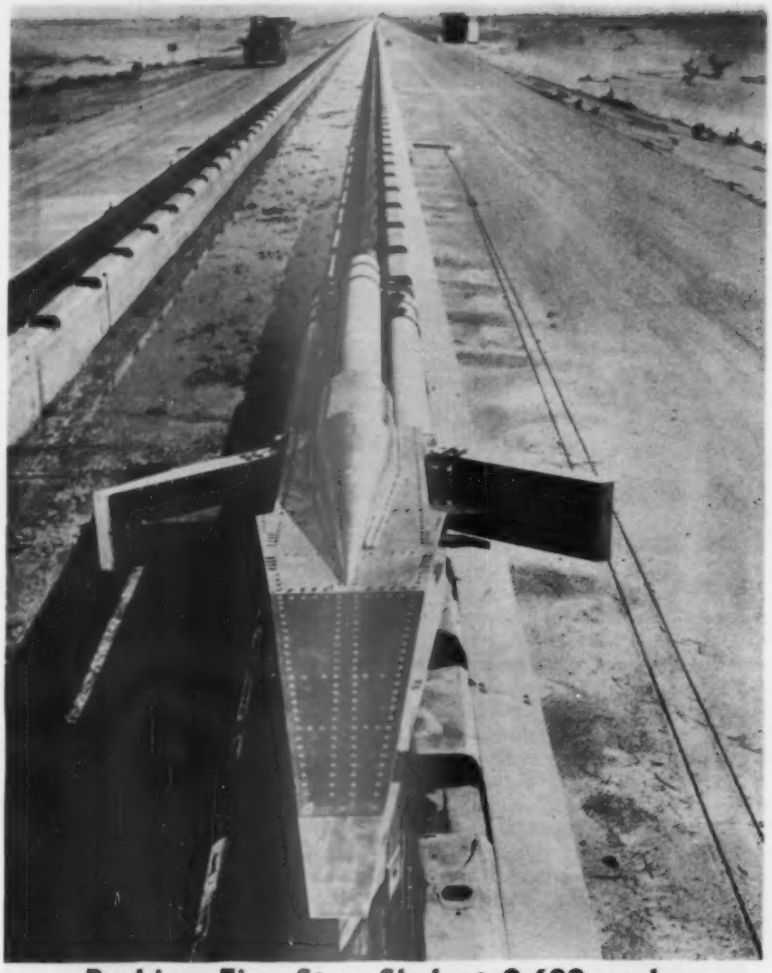
Directors of Permanent Filter Corp., Los Angeles, and Hydrodyne Corp., of North Hollywood, Calif., have agreed to an offer by Permanent Filter to acquire Hydrodyne, subject to approval by California Corporations Commissioner. Both firms are active in the missile fields.

Joint ownership of S. G. Brown, Ltd., Watford, England, has been acquired by American Bosch Arma Corp. and de Havilland Holdings, Ltd., a member company of the Hawker Siddeley Group. S. G. Brown, Ltd., is a producer of precision navigation and gyroscopic equipment.

Semicon Associates, Lexington, Ky., has been acquired by Varian Associates, Palo Alto, Calif., through a stock exchange. Dr. Otto G. Koppius, president of Semicon, was elected chairman of the board of directors of the wholly-owned subsidiary. Varian acquired all outstanding capital stock of Semicon and then issued 12,501 shares to the company, with additional shares issued in installments, to a maximum of 30,000 shares, but only if Semicon attains profits required by the acquisition agreement.

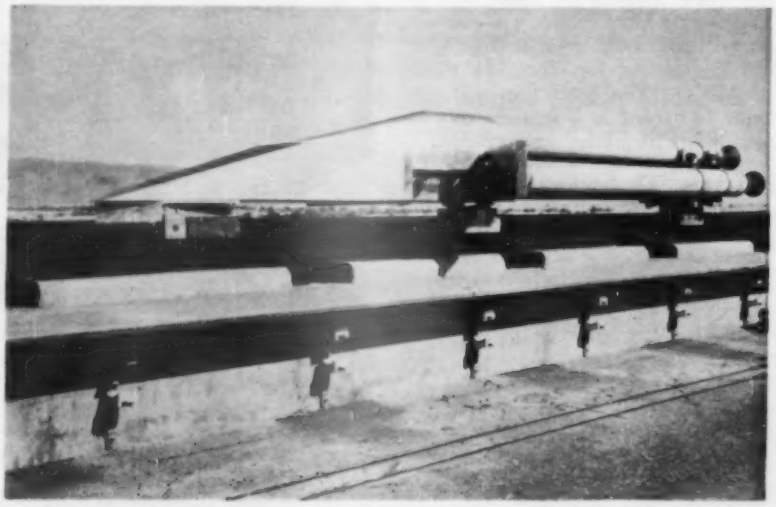
Raychem Corp., Redwood City, manufacturer of electrical and electronic insulation for missiles, aircraft and computers, has purchased Bentley-Harris Mfg. Co., Conshohocken, Pa., for 50,000 shares of Raychem stock. Latter firm produces sleevings and tubings for electrical insulation.

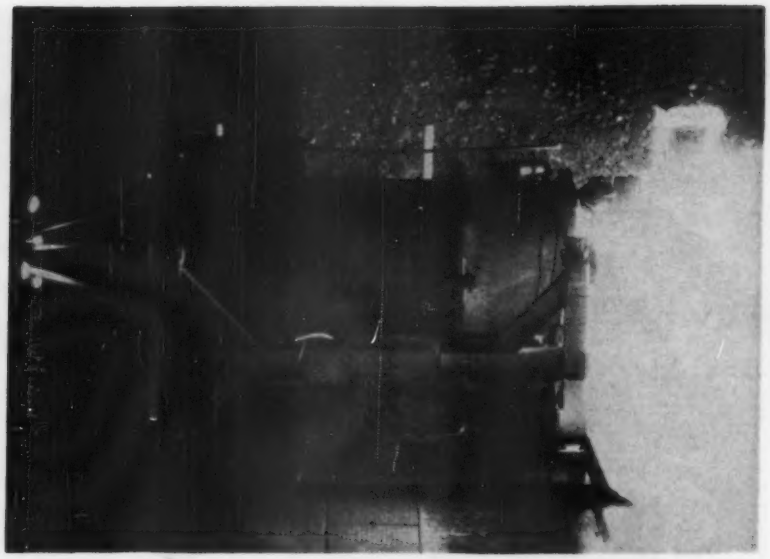
Directors of Northeast Metals Industries, Inc., Philadelphia, Pa., have approved a merger agreement with Vanguard Air & Marine Corp., builders of the Vanguard 2C fan wing airplane (AW Oct. 19, 1959, p. 128). Deal is subject to stockholder approval and was previously approved by Vanguard's



Braking Fins Stop Sled at 2,688 mph.

Extended braking fins safely halted rocket research sled designed by Northrop's Norair Division, Hawthorne, Calif., from a 2,688 mph. test run at Holloman AFB, N. M. Fins are fitted into sled's pointed nose in such a way that inertia keeps them closed until the instant of rocket burnout. Then the initial deceleration causes fins to open about two inches, after which they are fanned out to full braking capacity by the wind blast. The 16-ft. sled, now fully tested, will be used to test inertial guidance system components at the Air Force Missile Development Center.





Static Test Firing of Minuteman Second Stage

Successful static test firing of Minuteman second-stage rocket engine takes place at Aerojet-General Corp.'s Solid Rocket Plant, Sacramento, Calif. Second stage engine utilizes advanced solid propellants. Aerojet is prime source for the second stage propulsion system and is conducting research and development work on the propulsion system for the Minuteman third stage. A recent third-stage test made use of all-titanium casing for a large motor. One-third lighter than steel, titanium case withstood firing so well that the same casing will be reloaded for another test.

directors. Edward G. Vanderlip, Vanguard president, will head the new firm. Alfred B. Reischer, president of Northeast Metals, becomes board chairman. Merged corporation will retain the Vanguard name.

DACO Instrument Co., Brooklyn, N. Y., builder of gear heads, counters, timers and servo systems, has acquired the Motoroid Division of Leetronics, Inc., which makes rotary a.c. and d.c. solenoids.

All the stock of Applied Radiation Corp. (ARCO), Walnut Creek, Calif., has been acquired by High Voltage Engineering Corp. Stock was obtained on the basis of one share of High Voltage Engineering for every 10¾ shares of ARCO. The latter firm will continue to operate as a separate corporation under its present management.

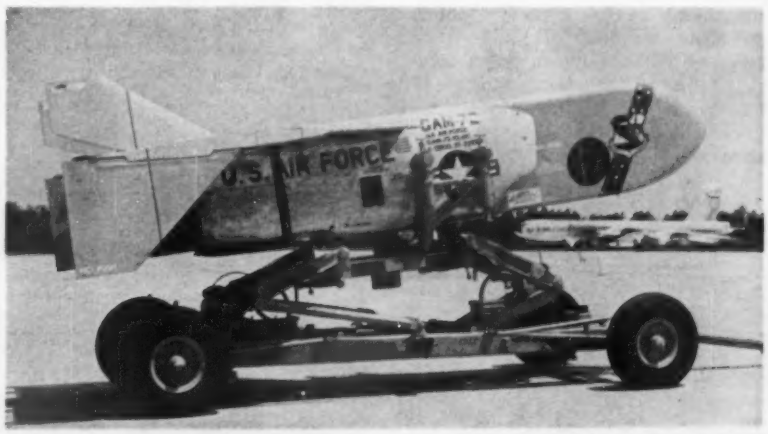
Textron Electronics, Inc., has acquired Allegany Instrument Co., Cumberland, Md., in exchange for 140,000 shares of Textron Electronics common stock. Allegany manufactures electronic and pressure measuring devices used in testing of rockets and missiles.

New Offerings

Control Data Corp., Minneapolis, Minn., engaged in the design, development, manufacture and sale of systems, equipment and components used in electronic data processing and automatic control for military, scientific and industrial uses, various instruments and control devices primarily for use in missiles and military aircraft, and electronic supervisory control and telemetering equipment primarily for power and gas utility and pipe line companies. Offering is 125,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Proceeds will be used to repay some $1,500,000 of bank loans; the balance for working capital and other corporate purposes.

Electronic Specialty Co., Los Angeles, Calif., engaged in designing, developing, manufacturing and selling electrical and electronic instruments and components as well as electronic systems and subsystems for military, industrial and scientific installations. Offering is 150,000 share of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Proceeds will be added to the general funds of the company in anticipation of its medium and long-term capital requirements, which may include the purchase of other businesses if favorable opportunities arise.

Cubic Corp., San Diego, Calif., engaged in the design, development and production of electronic devices and systems, primarily for the precision tracking of missiles, satellites and aircraft; a substantial portion of the company's business is research and development. Offering is 50,000 shares of capital stock; 25,000 shares to be offered for the account of the company and 19,000 and 6,000 shares for the respective accounts of Walter J. Zable (president) and Robert V. Werner (executive vice president). Offering price will be related to the current market price of the outstanding stock at the time of offering; underwriting terms to be supplied by amendment. Proceeds of the sale of 25,000 shares by the company will be used to provide additional working capital for anticipated further increases in its sales volume; the company expects to use $400,000 to build up



Quail Category II Tests Near Completion

Category II tests are nearing completion on the McDonnell GAM-72 Quail decoy missile, to be mounted on special racks in the bomb bays of Strategic Air Command B-52 bombers and released in salvos to penetrate and confuse enemy air defenses. When launched, Quail flies a similar flight path at the same speed as the B-52, producing a blip on enemy radar screens resembling that produced by the B-52.

inventories, $400,000 to finance receivables, and $200,000 to acquire additional electronic test and manufacturing equipment.

American Electronics, Inc., Los Angeles, Calif., engaged in the manufacture and sale of certain ground support equipment for use in the aircraft and missile industry; the manufacture and sale of certain electro-mechanical components for use in various electronic systems related to the aircraft and missile industry; the manufacture and sale of toll and fee computing, collecting and accounting systems for use on toll roads and in parking lots and garages; specialized environmental testing services; the manufacture and sale of nuclear testing equipment. Offering is 300,000 shares of common stock for public sale; initial public offering price will be related to the current market for outstanding shares at the time of offering; underwriting terms of be supplied by amendment. Of the proceeds, $200,000 will be used to acquire leasehold improvements for the plant and facilities being constructed by the company at Fullerton, Calif.; the remainder will be added to working capital, including the repayment of $1,500,000 of short term bank loans and the payment of $1,500,000 of current accounts payable.

Kinetics Corp., Solana Beach, Calif., a research-development-production organization specializing in airborne motor-driven switches, static inverters and static telemetry commutators used in aircraft and missile programs. On May 19, the company offered 50,000 shares of common stock at $6 per share, the first public stock issue made by the company since its organization in February, 1957; the entire issue was oversubscribed within five days.

Servonics, Inc., Alexandria, Va., an electronics design and manufacturing company, offered subscription rights for 76,600 shares to shareholders of record on May 25 (issue closed June 10), on the basis of one share per five held, at a price of $7 per share. Of the 76,600 shares, primary rights were exercised on 74,050 shares; shareholders requesting secondary subscription rights asked for an additional 70,459 shares. Of the proceeds it is anticipated that approximately $75,000 will be used for the purchase of additional equipment and facilities for company expansion; approximately $200,000 to provide additional working capital to finance contracts already proposed to the government; $100,000 to prepay a bank loan due in June 1962; up to $75,000 to finance initial payments on property being sought for construction of a facility in the northern Virginia area.

DC-8

JETS GET THEIR FLIGHT PLAN DATA PROCESSED BY COMPUTOR HOUSED IN

EMCOR® CABINETS

An EMCOR cabinet houses an electronic computer designed to furnish flight plan data for DC-8 Jet Mainliners, United Air Lines, Chicago, Illinois. The computer stores in its memory the operating and performance characteristics of the DC-8 aircraft, including such things as fuel flow, air speed, rate of climb, routes, altitude restrictions, compass headings, distance between check points, etc.

EMCOR design "know-how" in producing standard cabinets featuring the most modern concept in metal cabinetry is keeping pace with the new age in air travel. The flexibility, versatility and structural capabilities of over 600 basic frames in the EMCOR MODULAR ENCLOSURE SYSTEM bring advanced engineering and "imagineering" to meet electronic and instrument packaging requirements.

CONDENSED VERSION OF CATALOG 106 AVAILABLE UPON REQUEST.

QUALITY EMCOR PRODUCTS

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Ingersoll PRODUCTS DIVISION
BORG-WARNER CORPORATION
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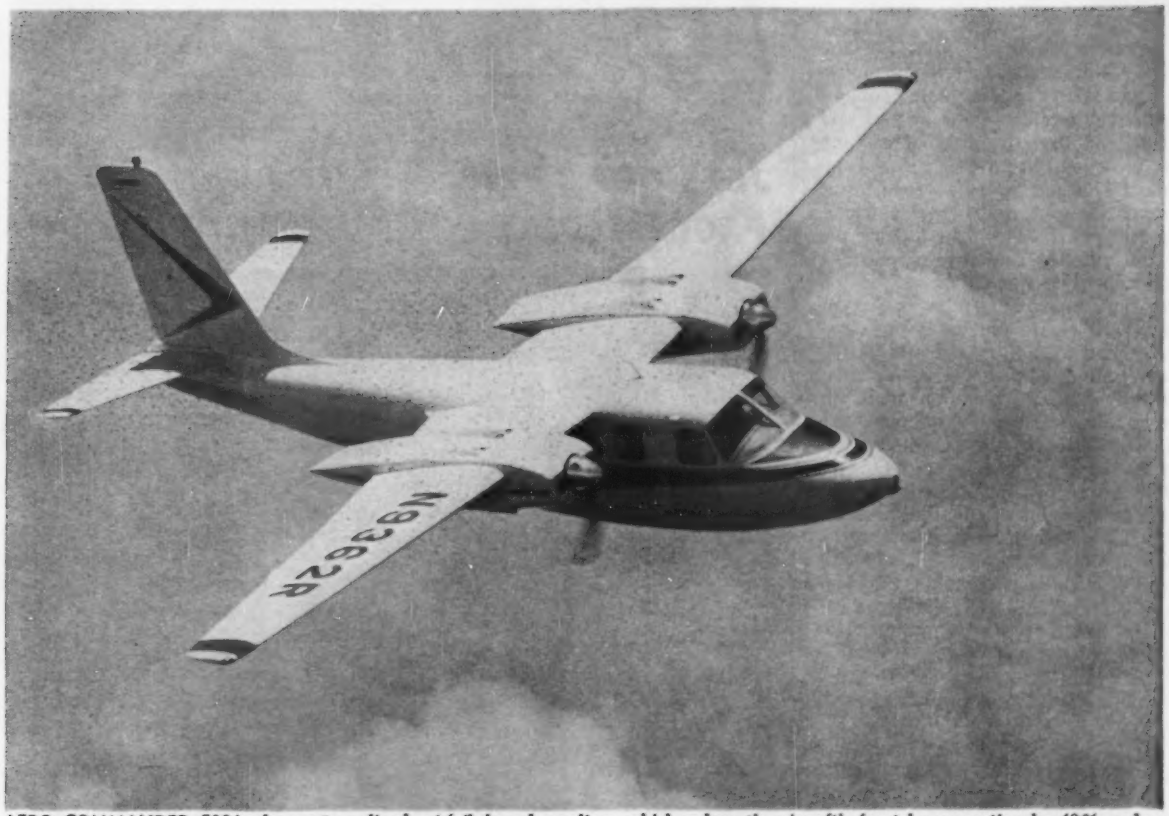


AERO COMMANDER 500A shows streamlined, airfoil-shaped cowlings which reduce the aircraft's frontal cross-section by 40%, reducing drag about 10%, and increasing takeoff and single-engine performance. Engines are Continental IO-470-Ms with fuel injection.

Aviation Week Pilot Report:

Aero Design's 500A Shows Power Gain

By Robert I. Stanfield

Reading, Pa.—Improved performance of the new Aero Commander 500A reflects the extensive design and configuration changes—including the installation of fuel injection engines—that Aero Design & Engineering Co. (Bethany, Okla.) has worked into its line of executive aircraft.

The 500A, the first and lowest-priced of the new Commander line, will pose few problems for the executive pilot who may fly less frequently than the professional. Cruise speeds of 200 mph.-plus, fuel consumption of less than 7 gal./hr. at 31% power, marked slow-flight stability and good engine-out characteristics were evidenced during evaluation by AVIATION WEEK.

Six- to seven-place light twin is powered by two Continental IO-470-M fuel injection engines, each generating 260 bhp. at 2,625 rpm. Propellers are two-bladed Hartzells of 80 in. maximum and minimum diameter. Cruise speed, 70% power, 10,000 ft., is specified as 220 mph. Range, 45% power with 30 min. fuel reserve, is 1,800 mi. Service ceiling is 23,500 ft. Empty weight is 4,075 lb.; maximum gross is 6,000 lb.

Design Features

New Commander represents the biggest changes in configuration since the company introduced its pressurized Model 720 in 1957. The low-drag, flat, airfoil-shaped cowlings mark a 40% reduction in aircraft's frontal cross-section, reducing drag some 10% and increasing takeoff and single-engine performance (AW Apr. 11, p. 117). Revised main gear retraction system turns the wheels 90 deg. so that they lie flat and within the contours of the nacelle underside. Rapid gear extension and retraction runs to about 3.5 sec.

Airfoil characteristics of the cowlings have reduced stall speeds some 5-6 mph. Nacelles, which themselves provide lift, add to more mean effective wing surface. Airplane's lift/drag ratio has jumped from 11-12:1 to 15-16:1. Cowlings, 9 in. less deep than on previous models, add to increased side visibility. Previously used augmenter tubes, for cooling, have been replaced by exhaust ports which dump exhaust at the maximum negative pressure area on top of each wing, and aid in reducing cabin noise.

Engines are cooled via two electrically-operated "flaps" atop each nacelle, though aircraft usually are flown (including this evaluation) with cowl flaps closed. There should be few temperature problems with the new Commanders; company, to avoid excessive cooling, also has closed off 60% of one side of the air intake for each engine, which also aids in drag reduction.

Though performance gross weight of the 500A is 6,000 lb., the airplane can be loaded up to the maximum structure gross weight of 8,000 lb., adding to its

adaptability for export work—transatlantic crossings.

Basic cost of the 500A is $72,000. The first of about 15 models produced by early June was delivered to Big Brother Aircraft Co., Atlanta, Ga. The first of the Model 500B series was rolled out in mid-June and will be priced at $81,500. The new Model 680F will be available in early July, at a basic cost of $113,500. By late July the Model 560F will be available at a cost of $98,500. Pressurized Commander, the 720A, will be available later this year.

Aero Design already has sold this year's production (over 100 aircraft) and output has been stepped up from 12 aircraft monthly in January to 18 currently. Commanders are built to order, and the plant maintains no inventory of finished aircraft. Backlog currently numbers 82 airplanes, with delivery dates now about five months from time of order. Aero Design employes have increased from 746 in January to 935 at present.

500A Demonstrator

Demonstrator Commander 500A used in this AVIATION WEEK evaluation was N9362R, the second aircraft to come off the Aero Design production line. It's a smart looking airplane, the biggest noticeable change being in the sleek, flat look of the engines. The powerplants are raised 4.15 in. over previous installations, increasing propeller tip clearance with the fuselage.

Cowlings are hinged on the lower side, quick release latches exposing most of the engines. Aft end of the cowling can be slid back and lowered to the ground. Engines are mounted on single-piece aluminum forgings. Five fuel tanks drain to a central sump. There is no cross-over valving in the fuel system; there is but one fuel gage and one filler. Total capacity is 156 gal.

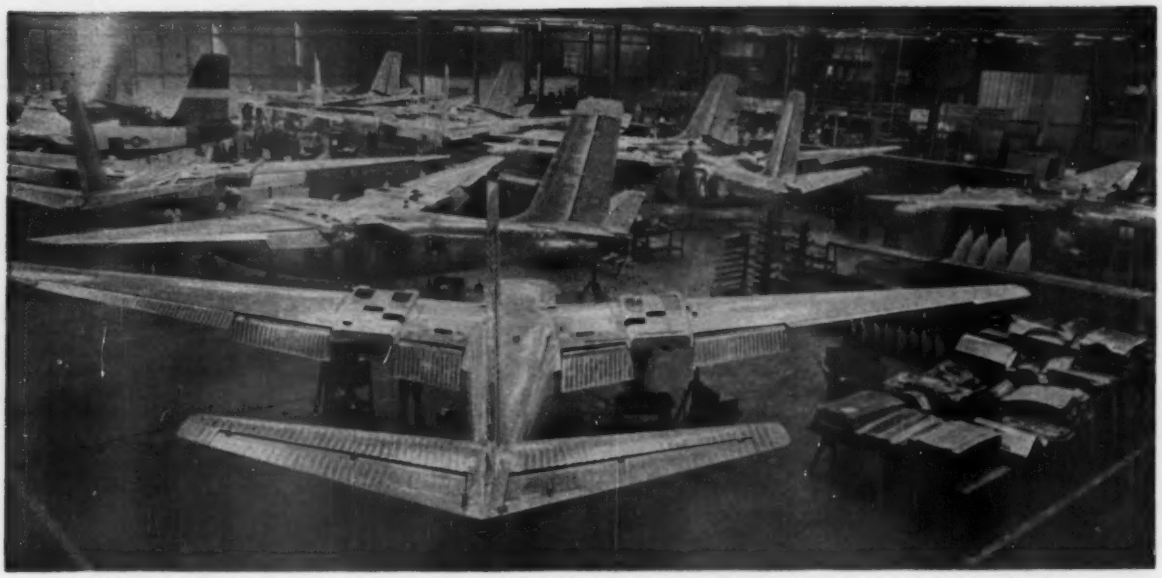
Battery compartment and external power supply hook-up are located on the aft left side of the fuselage. Two 12-v. batteries are hooked in series. Low-level baggage space is located just aft of the entrance door, left side, with a volume of 37 cu. ft. and a maximum capacity of 350 lb. Radio racks are easily accessible through the rear of the baggage compartment.

Cabin interior is made up of upholstered metal strips, which are easily unbuttoned and replaced. Demonstrator contained three seats, in addition to the dual cockpit seating, plus a track for a sixth seat. For passenger comfort and convenience there are curtained windows adjacent to all seats, a ceiling coat rack, flush mounted ash trays, and overhead vents and reading lights recessed into valence panels. Flush mounted aft of the pilot's curtain track are "fasten seat belts" and "no smoking" signs, actuated from the

500A cruises at 220 mph., has service ceiling of 23,500 ft., range of 1,800 mi.

REVISED main gear retraction system on the 500A turns wheels 90 deg. so that they lie flat and within the contours of the nacelle underside. Gear retracts in 3.5 sec.

ENGINE instruments are mounted in the center panel of the 500A, along with the gear handle, directly above control quadrant. Main panel can take dual flight instrumentation.



AERO COMMANDER production line at company's Bethany, Okla., plant has increased production from 12 to 18 aircraft per month.

gear-down safety light switch. Cockpit seating in the 500A is comfortable, and visibility from ground level is good. Engine instruments are mounted in the center panel, along with gear handle, directly above control quadrant. Flight instruments in this airplane are seated in the left main panel; copilot's side was bare, but could take duplicate flight instruments.

Light gray panel provided good contrast to instrument coloring.

Standard Equipment

All equipment in this airplane is standard, with the exception of the complete Dare radio package, including 360 channel transceiver, two 560-channel omnis, glide slope, three-light marker, ADF, etc. Package includes switch-over tuning; all radios are on one panel. All electrical and starting switches are located overhead, in one row, along with elevator and rudder trim.

Turning on of master switch automatically actuates an electric hydraulic pump that provides pressure for brakes and flaps; system will bring pressure up to 570 lb. at any time it falls below 500 lb. Continental engines of the 500A fired up easily, and with toe-tip pressure for braking as necessary, airplane was smoothly maneuvered from the ramp out to run-up position.

Field elevation at Reading Municipal Airport (Gen. Spaatz Field) is 343 ft. Sea level pressure at takeoff was 29.89 in. Wind was calm. Outside air temperature was 72F. With three of us aboard, including Clarence Morgan, director of sales training for Aero Design, and Jim Watson, service manager, the 500A grossed out at about 5,610 lb.

Takeoff and Climb

Before takeoff 10 deg. of flaps were lowered to give airplane a "flat" attitude rather than nose-high when breaking ground; this also adds to back-seat passenger comfort. With full power applied, the Commander moved quickly down the runway. We went to high boost on the roll, at full power, to avoid loading. Aircraft is also leaned out on takeoff (to 90 lb./hr.) for the same reason, since engines burn about 115 lb./engine/hr. on reduction to 2,550 rpm. in climb-out.

Nosewheel of the 500A was eased off at 65 mph. and, as aircraft became airborne after a run of about 1,600 ft., "flat" attitude was held as speed quickly built up to 140 mph., best for initial climb and single-engine performance. Minimum single-engine control speed is 70 mph.

With gear, then flaps retracted, the Commander was held to 850 fpm. rate of climb.

Noise level was moderate, and visibility was good.

At 500 ft., climbing, the port engine was pulled back to zero thrust. Direc-

Aero Commander 500A

Performance*

Maximum speed (sea level)	230 mph.
Cruise speed (70% power, 10,000 ft.)	220 mph.
Cruise speed (75% power, 5,000 ft.)	206 mph.
Stall speed (gear and flaps extended	61 mph.
Range (45% power, 10,000 ft., 181 mph. TAS, 30 min. reserve normal fuel)	1,800 mi.
Service ceiling	23,500 ft.
Service ceiling (one engine)	10,100 ft.
Rate of climb (sea level)	1,570 fpm.
Rate of climb (single engine, sea level)	430 fpm.
Takeoff distance (over 50 ft.)	1,200 ft.
Landing distance (over 50 ft.)	1,130 ft.

*(Based on full gross weight. Speeds guaranteed plus or minus 3%. Climbs, ranges and altitudes guaranteed within plus or minus 8%.)

Aero Commander 500A

Specifications

Height	14 ft. 6 in.
Length	35 ft. 1.25 in.
Wing span	49 ft. 6 in.
Wing area	255 sq. ft.
Wing loading	23.6 psf.
Power loading	11.5 lb./hp.
Empty weight	4,075 lb.
Useful load	1,925 lb.
Maximum gross weight	6,000 lb.
Fuel capacity	156 gal.
Cabin:	
Height	53 in.
Width	52 in.
Length	129.5 in.
Baggage compartment:	
Dimensions	41 x 47 x 31 in.
Volume	32 cu. ft.
Door size	23.5 x 19.5 in.
Gear tread	12 ft. 11 in.

Engines: Two Continental IO-470M direct drive, horizontally opposed, six-cylinder, air-cooled fuel injection engines, each generating 260 bhp. at 2,625 rpm. Propellers: Hartzell HC-A2XF-2B/8433 (two blade) 80-in. maximum and minimum diameter.

tion was maintained with about 12 deg. aileron (no rudder) and aircraft attitude was held constant as airspeed dropped to stabilize at 105 mph. Climbing through 1,000 ft. in this configuration, airplane ascended at 500 fpm. At 1,500 ft., still climbing with airspeed indicating 100 mph., rate of climb was 400 fpm. During this single-engine climb the cowl flaps remained closed, both engines holding to temperature norms.

Bringing back the power on the "dead" engine, airplane passed through 4,000 ft. indicating 125 mph. and climbing 1,100 fpm. Stability of the 500A was good; hands off flight could be set up during straight-ahead ascent and during climbing turns incorporating 20 deg. of bank. The airplane ascended by itself through 6,500 ft., power to 23 in. manifold pressure and 2,550 rpm., indicating 125 mph. and climbing 500 fpm.

Cruise Settings

At 7,000 ft., the 500A was leveled off for runs at varied cruise settings with these results (outside air temperature 8C):

- **65% power.** Pulling 23 in. and 2,400 rpm., good for about 7 hr. of flying, plus time to alternate, the Commander indicated 170 mph. for true reading of 196 mph. Fuel flow was 66 lb./hr., about 11 gal./hr. for each engine.
- **45% power.** With engines back to 20 in. and 2,100 rpm., the airplane indicated 145 mph. for a true airspeed of 170 mph. Fuel flow was 40 lb./hr. each engine, or less than 13 gal./hr. total. This would allow approximately 12 hr. endurance.
- **31% power.** Reduction to 14 in. manifold pressure and 2,100 rpm. resulted in indicated airspeed of 120 mph. —normal holding and approach speed. Total fuel consumption was 40 lb./hr., or less than 7 gal./hr. Stability at this speed was apparent as the 500A, with boost of 1 in. to 15 in. manifold pressure, flew hands-off in 15 deg. bank, indicated speed dropping to 115 mph. Aid to the pilot during long holding periods was obvious.

Slow-Flight Stability

During this hands-off, slow-flight demonstration, without touching controls, gear and one-quarter flaps (10%) were lowered. The airplane stabilized quickly at 120 mph. indicated, descending at the rate of 500 fpm. Course held steady. With gear and flaps raised—simulated a missed approach—the 500A went "cross field" at 120 mph., with the same fuel flow (and evidencing good fuel management).

Missed approach climb-out was initiated by boosting power to 23 in. manifold pressure, leaving the same trim.

The buyer of an airplane with

CONTINENTAL POWER

obtains two plus values available nowhere else. One is Continental's famous reliability; the other, the priceless backing of genuine Continental parts and factory-approved service no matter where he may fly.

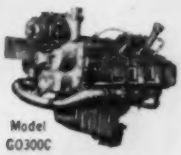
After engine dependability, the most important thing to consider in choosing an airplane is the service behind it—the facilities maintained by its makers to keep it in the air at lowest cost. And here, as on the basic score of engine stamina, planes with Continental power rate uniformly high . . . Owners of such aircraft are sure of finding genuine Continental parts and competent mechanics the world over . . . They benefit in other ways, too, from Continental's policy of backing those who build and those who use Continental-powered products.

21 MODELS—65 TO 340 HORSEPOWER

MODEL	HP	RPM	CYL.	WT.	OCTANE
A65	65	2300	4	173	80/87
C90	95	2625	4	207	80/87
O200-A	100	2750	4	190	80/87
O300-A B & C	145	2700	6	277	80/87
GO300-C	175	3200	6	312	80/87
O470-15***	213	2600	6	405	80/87
E225	225	2650	6	363	80/87
O470-K & L	230	2600	6	404	80/87
O470-M	240	2600	6	409	91/96
O470-G	240	2600	6	432	91/96
O470-H*	240	2600	6	472	91/96
IO470-C	250	2600	6	432	91/96
IO470-D	260	2625	6	426	100/115
IO470-F	260	2625	6	426	100/130
IO470-J	225	2600	6	402	80/87
IO470-K	225	2600	6	391	100/130
FSO526-A**	270	3200	6	575	91/96
GSO526-A	340	3160	6	549	91/96

*Pusher Type engine with extended propeller shaft
**Helicopter engine ***For Military use

Model O200-A


Model GO300C

Model IO470-J

Model FSO526-A

Continental Motors Corporation
AIRCRAFT ENGINE DIVISION
MUSKEGON, MICHIGAN

APPARATUS DIVISION

TEXAS INSTRUMENTS
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Esso

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mph. and ascended at 500 fpm. The stability of the 500A does a fine job for the pilot.

The Commander 500A has a good sink rate and a moderate rate of descent, with engines to zero thrust and airplane held to level attitude. This was demonstrated by Morgan, who reduced power to 10 in. and 2,100 rpm. at 7,200 ft. Nose trim was rolled high. With feet off rudder pedals, the airplane lost about 750 to 800 fpm. during descent. Speed held to 80 mph. indicated. The Commander was moved off the sink rate by boosting manifold pressure to 16 in.

Stall Speed

The airplane was stalled in landing configuration (gear and full flaps extended), power to zero thrust (10 in. manifold pressure), at 6,000 ft. Stall warning was evidenced about 7-10 mph. before the break, with aileron control alone holding the Commander level. Stall speed approximated 59 mph. indicated. Initially this pilot had a tendency to hold the nose high, with a resultant dropping of the right wing, but normal attitude was held during succeeding attempts with normal procedures applied.

Single-engine, with 55% power applied to starboard powerplant (22 in. and 2,200 rpm.), buffet occurred at 65 mph. indicated. Again, with aileron control alone, the attitude was held and recovery was quick. With power again advanced, and climb initiated at 80 mph. indicated, rate 700 fpm., cowl flaps still remained closed, cylinder head temperatures holding to 188C—in the green.

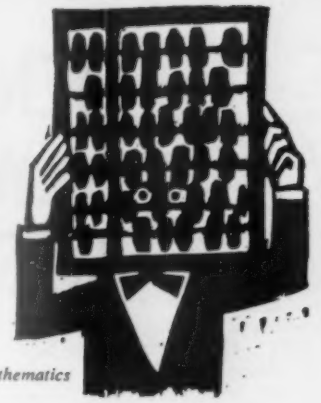
Rough Air

Again at zero thrust, the airplane had no tendency to wind up during descent. With gear and flaps extended, airspeed now indicating 150 mph., the 500A moved through 5,000 ft. at 400 fpm. At 4,500 ft. power was advanced to 25.5 in. and 2,450 rpm. for a run through some unstable air. Rough air characteristics over the Pennsylvania hills were good. With outside air temperature 15C, the 500A indicated 210 mph., still 20 mph. below V_{mo}. Airplane is yellow-lined at 230 mph. and red-lined at 290 mph. The spread makes a critical position difficult, in any aspect.

Maximum speed for gear extension is 180 mph.; for half flaps, 150 mph.; for full flaps, 136 mph. Positive limit load factor is 3.6g. There is nothing critical about the pattern speeds, which usually run from 120 mph. (also for instrument work) to a final approach at 100 mph., the airplane normally being brought over the fence at 90 mph. and set down at 70-72 mph.

We used these speeds during our initial approach and landing, which re-

PROBLEMATICAL RECREATIONS 22



A certain number is the product of three prime factors, the sum of whose squares is 2331. There are 7560 numbers (including unity) which are less than the number and prime to it. The sum of its divisors (including unity and the number itself) is 10, 560. What is the number?

—*School Science & Mathematics*

Integrated Data Processing, Inc., which converts coded numerical information from punched paper tape into finished financial statements, has been acquired by Monroe Calculating Machine Co., Inc., one of our divisions.

ANSWER TO LAST WEEK'S PROBLEM: The hour and minute hand coincide 11 times in 12 "hours." Your watch gains 5/11 minutes every 65, or 1 hour every 143.

LITTON INDUSTRIES
Beverly Hills, California

Environmental testing of TARmac ASR-4 Airport Surveillance Radar System, developed and produced for the Federal Aviation Agency.

TI IN HEAVY RADAR SYSTEMS

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BENDIX ANNOUNCES NEW AND EXTENSIVE WEST COAST FACILITY

FOR CABLING USED ON GROUND BASED ELECTRONIC EQUIPMENT

Scintilla Division of Bendix has scheduled for September completion this new 30,000-square-foot plant at 1001 S. Grand Ave., Santa Ana, Calif. It will offer West Coast users the finest, most complete facilities in the area devoted exclusively to development and manufacture of cabling used on ground based electronic equipment.

West Coast missile industry producers, particularly, will benefit by having this new facility "on their doorstep," bringing them the latest and best in cabling for missiles and supporting ground equipment.

Sales and service for *all* Scintilla Division products—including cables and connectors—will continue to be handled out of 117 E. Providencia Ave., Burbank, Calif.

Scintilla Division
SIDNEY, NEW YORK

THE Bendix CORPORATION

Emeraude Awarded Airworthiness Certificate

Emeraude CP-301A, manufactured by Piel Aviation, Le Drancy, France, has been awarded an airworthiness certificate recently although several hundred had already been built and were flying under restricted certificates. The Emeraude CP-301A, a later development of the CP-30 which first flew in 1952, is powered by a 90 hp. Continental C90-F14 engine. The two-seater cruises at 120 mph., has an empty weight of 836 lb., gross of 1,408 lb. and a range of 600 mi. with 30 min. fuel reserve.

sulted in a minimum of roll. On succeeding go-arounds we tried both a deliberately high approach and one in which zero thrust was used on a long base leg. In the former, the airplane was held to 1,000 ft. above the runway, on final, until we lost the approach end under the nose. Ordinarily this would mean a go-around, but with use of sink-rate described earlier we easily got in to the 5,151 ft. strip with plenty of room to spare.

Before running through the zero thrust approach, from base leg, a short-field takeoff was made with the 500A trimmed 8 deg. nose up and half flaps extended. The airplane, with no wind, was off the ground at a high angle after a run of but 900 ft. Coming around for the final landing, power on both engines was reduced to 11 in. manifold pressure and 2,250 rpm. on base leg, where 10 deg. of flaps were dropped. With airspeed held to 110 mph. indicated, the airplane held to a 900 fpm. rate of descent. Full flaps were extended on final, again flown at 100 mph. At no time was an increase in power necessary.

Operating Costs

Hourly operating cost of the Commander 500A is estimated at $18.75. Breakdown of Aero Design hourly figures follows:

• **Inspections.** Normal 100-hr. inspections, $2.75; normal 50-hr. inspections, 50¢.

• **Overhaul and maintenance.** Radio overhaul and maintenance, 60¢; instrument overhaul and maintenance, 50¢; propeller overhaul each 900 hr., 22¢; remanufactured engines each 900 hr., $3.90.

• **Fuel and oil.** Fuel, on the basis of 26.6 gal./hr. at 36¢ per gal., $9.58. Oil consumption one pint per hour, and change at 50 hr., 70¢.

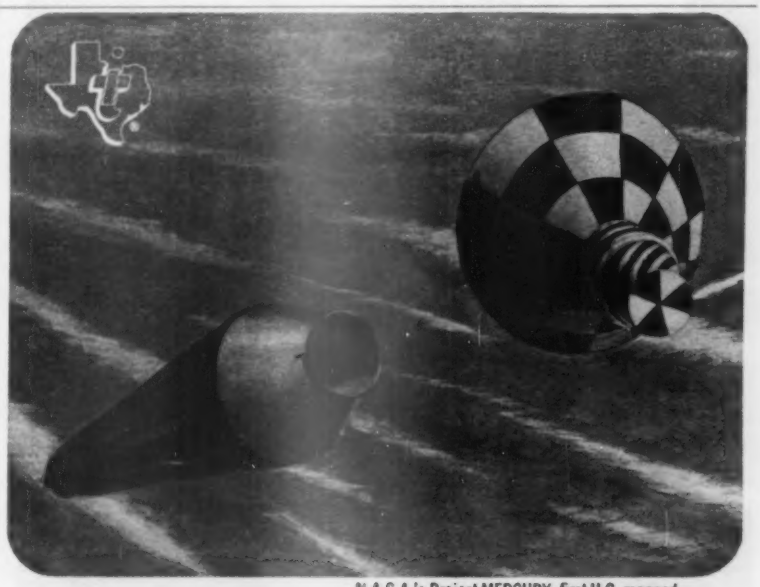
PRIVATE LINES

Oakland Airmotive's Super-V light twin, a conversion of the Beech Bonanza to twin engine configuration (AW Oct. 20, 1958, p. 108), has been certificated by Federal Aviation Agency. E. H. Gough, Oakland Airmotive president, said a national sales program will start immediately, under direction of Ken Bellamy, sales manager. Super-V powerplants are two Lycoming 150 hp. engines installed in low drag nacelles.

Field Aviation Co., Ltd., Toronto, Can., is spending about $1 million on aircraft storage, sales and overhaul facilities at Malton Airport. Completion date is August, according to Victor Koby, general manager. Field Aviation also has facilities at Oshawa, Calgary and Ottawa.

Air Associates, Inc., Teterboro, N. J., has formed an international division for overseas sales. Division is managed by Adolph Fibel.

Air Taxi Co., of Newark, N. J., will offer charter and air taxi service out of Greenwood Lake Airport, West Milford, N. J. James Loeb, Air Taxi president, said company also will operate a flight school.



N.A.S.A.'s Project MERCURY, first U.S. manned Space Capsule, built by McDonnell Aircraft.

TI TRANSMITTERS IN SPACE EXPLORATION

APPARATUS DIVISION

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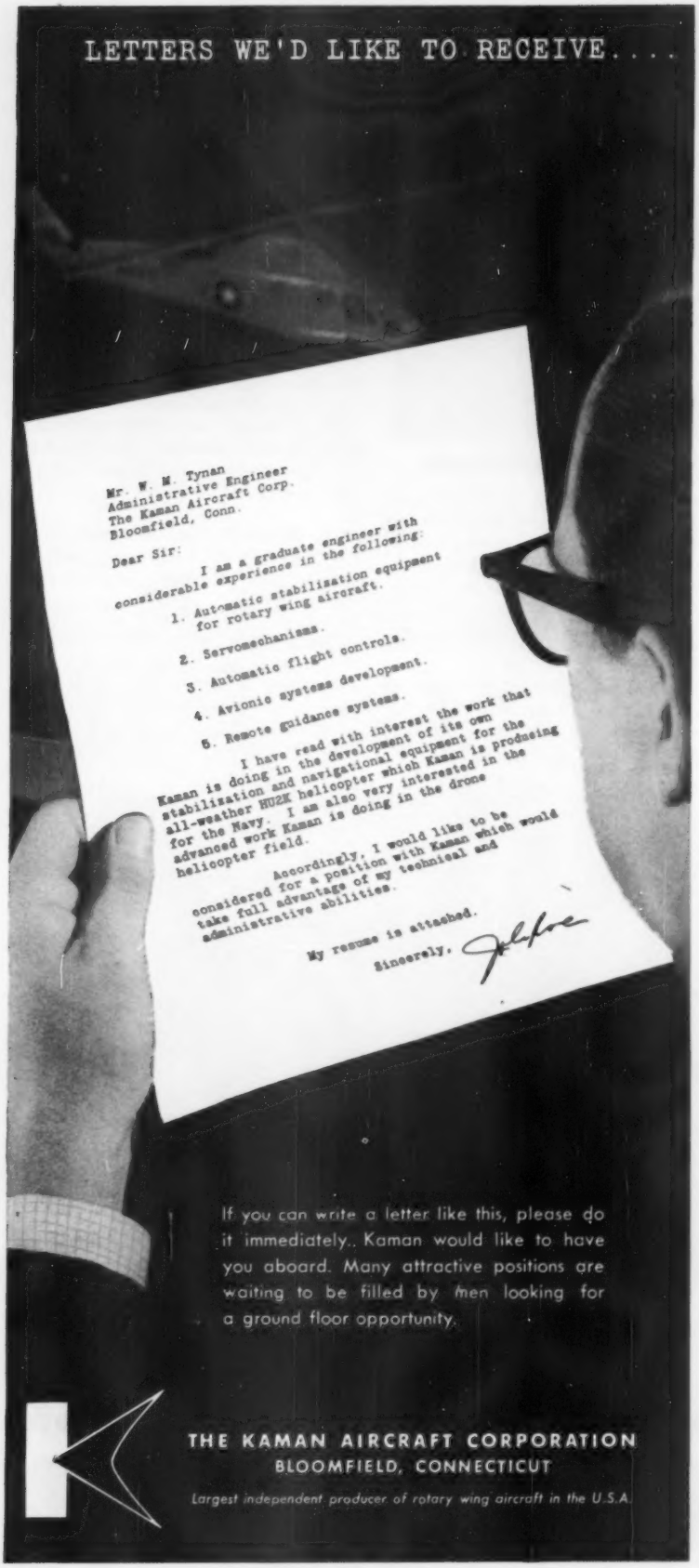
LETTERS WE'D LIKE TO RECEIVE....
Mr. W. M. Tynan
Administrative Engineer
The Kaman Aircraft Corp.
Bloomfield, Conn.
Dear Sir:
I am a graduate engineer with considerable experience in the following:
1. Automatic stabilization equipment for rotary wing aircraft.
2. Servomechanisms.
3. Automatic flight controls.
4. Avionic systems development.
5. Remote guidance systems.
I have read with interest the work that Kaman is doing in the development of its own stabilization and navigational equipment for the all-weather HU2K helicopter which Kaman is producing for the Navy. I am also very interested in the advanced work Kaman is doing in the drone helicopter field.
Accordingly, I would like to be considered for a position with Kaman which would take full advantage of my technical and administrative abilities.
My resume is attached.
Sincerely,
If you can write a letter like this, please do it immediately.. Kaman would like to have you aboard. Many attractive positions are waiting to be filled by men looking for a ground floor opportunity.
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Navy Contracts

Philadelphia—Following is a list of unclassified contracts for $25,000 and over as released by the Aviation Supply Office, U. S. Navy:

Servo Corp. of America, Hicksville, N. Y., potentiometers, used on computers for various blimps, N383-64599A, dated May 2, 1960, (383/218082/60), various, $28,339.

Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., strut assemblies, nose shock, for F11F aircraft, N383-64600A, dated May 5, 1960, (383/217399/60), various, $78,436.

Clark Cable Corp., Cleveland, Ohio, ring assemblies, fire retaining seal, for various aircraft, N383-64637A, dated May 4, 1960, (IFB 383-573-60), various, $31,242.

General Electric Co., Philadelphia, Pa., amplifiers, to support compass controlled directional gyro system on various aircraft, N383-64876A, dated May 3, 1960, (383/216816/60 and 383/218243/60), 194 ea., $256,080.

Tektronix, Inc., Portland, Ore., oscilloscopes, N383-65264A, dated May 2, 1960, (383/238009/60), 40 ea., $46,552.

Irving Air Chute Co., Inc., Lexington, Ky., parachute assemblies, personnel, chest type, NC3-R, N383-64715A, dated May 3, 1960, (383/271063/60, 383/271096/60 and 383/271159/60), 3,858 ea., $489,927.

Elizabeth Division, Elastic Stop Nut Corp. of America, Elizabeth, N. J., lights, beacon, flashing, gas operated for airfield lighting, N383-64951A, dated May 4, 1960, (383/236423/60), 14 ea., $35,613.

The Goodyear Tire & Rubber Co., Akron, Ohio, disks, to support brake assemblies for the F3H-2, -2M and -2N aircraft, N383-65379AA, May 4, 1960, various, $45,833.

The Liquidometer Corp., Long Island City, N. Y., transmitters, liquid, to support fuel quantity instrumentation systems on various aircraft, N383-65110A, dated May 6, 1960, (383/216956/60, 383/216990/60 and 383/218164/60), various, $111,827.

The Goodyear Tire & Rubber Co., Akron, Ohio, linings, brake, used on brake assemblies on various aircraft, N383-65382A, dated May 4, 1960, (383/211513/60), various, $207,519.

B. F. Goodrich Aviation Products Division, B. F. Goodrich Co., Akron, Ohio, glove assemblies, high altitude, for full pressure suit, N383(MIS)65177A, dated May 6, 1960, (MIPR 36-600-0-110 (Item 4)), 290 ea., $31,900.

Lear, Inc., Grand Rapids, Mich., control assemblies, to support autopilot for various aircraft, N383-64878A, dated May 5, 1960, (383/216284/60), various, $47,889.

Patten Co., Inc., Lake Worth, Fla., life rafts, inflatable, twenty man, N383(MIS) 64725A, dated May 6, 1960, (MIPR-09-603-0-4220-12), 2,075 ea., $718,884.

Firestone Tire & Rubber Co., Akron, Ohio, tanks, fuel, for A4D aircraft, N383-64613A, (383/224391/60), various, $42,619.

Wallace O. Leonard, Inc., Pasadena, Calif., valves, to support oxygen systems on F4D-1 aircraft, N383-64731A (383/212137/60), various, $202,818.

Pioneer-Central Division, Bendix Aviation Corp., Davenport, Ia., transmitters, rate of flow, fuel, to support various aircraft, N383(17-383)64239A, (PR-AER,4402-60), various, $228,989.

B. F. Goodrich Aviation Products Division, B. F. Goodrich Co., Akron, Ohio, torso assemblies, high altitude full pressure suit, N383(17-MIS)64732A, (PR-AER-231/60), various, $4,174,083.

Walter Kidde & Co., Inc., Belleville, N. J., services and materials to refill and service containers, bromotrifluoremethane, N383-63375A, (383/246322/60), various, $43,063.

The Berger Brothers Co., New Haven, Conn., coveralls, anti-blackout suits, N383-65159A, (IFB 383-534-60), 2,141 ea., $41,214.

Sperry Phoenix Co. Division, Sperry Rand Corp., Phoenix, Ariz., amplifiers, servo, for A4D-2 aircraft N383-64665A, (383/216831/60), various, $58,592.

Ganary Brothers, Mt. Ephriam, N. J., tension bars, used in launching carrier based aircraft, N383-65017A, (JD-IFB-383-703-60), various, $40,670.

Light Military Electronics Department, General Electric Co., Johnson City, N. Y., motors, to support various controls on F3H-2, -2M, -2N and F9F-6 aircraft, N383-64856A, (383/216690/60), 128 ea., $40,948.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., frame assemblies, used on indicators for various aircraft flight instruments, N383-64681A, (383/216205/60), various, $88,056.

Light Military Electronics Department, General Electric Co., Johnson City, N. Y., motor assemblies, to support directional gyro for various aircraft, N383-64858A, (383/218245/60), 170 ea., $54,385.

Rocket Power/Talco Division, The Gabriel Co., Mesa, Ariz., head assemblies, used on winches for HU8 aircraft, N383-64395A, (383-211396/60), various, $35,303.

Elastic Stop Nut Corp. of America, Elizabeth, N. J., lights, beacon, flashing, gas operated, N383-64952A, (IFB-383-695-60), 17 ea., $42,989.

Gould-National Batteries, Inc., St. Paul, Minn., batteries, storage, aeronautic, dry and charged, N383-64983A, (IFB 383-737-60), various, $128,257.

Radioplane Division, Northrop Corp., Van Nuys, Calif., cowl and box assemblies, to support KD2R-5 drone targets, N383-65013A, (383/226183/60), various, $83,036.

B & H Instrument Co., Inc., Fort Worth, Tex., probes, used on jet cal testers, N383-64987A, (383/262216/60), various, $48,469.

Fram Corp., Providence, R. I., filters, element, for various aircraft, N383-64639A, (IFB 383-613-60), various, $63,909.

R. and C. Machine Co., Inc., Dayton, Ohio, hoists, portable bomb, Aero 14B, N383-65001A, (IFB 383-630-60), 318 ea., $73,935.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., control assemblies, for WV-2 aircraft, N383-64851A, (IFB 383-630-60), 59 ea., $30,019.

Continental Electric Co., Inc., Newark, N. J., dynamotors, used with airborne radio communication equipment, N383-64846A, (383/231209/60) and 383/231301/60), 2,096 ea., $106,896.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., valves, to support propellers for various aircraft, N383(MIS64864A, (MIPR-09-603-0-1610-21), various, $244,799.

Hoover Electric Co., Los Angeles, Calif., actuators, for FJ-4, -4B aircraft, N383-64793A, (383/211454/60), 166 ea., $65,736.

General Electric Co., Johnson City, N. Y., units, synchronizing, for F3H-2, -2M and -2N aircraft, N383-63865A, (383/216572/60), 35 ea., $46,445.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., controls, to support automatic pilot systems for F2H-3, F9F-6K and R4Q-2 aircraft, N383-64868A, (383/216732/60), 90 ea., $46,374.

Buffalo Hydraulics Division, Houdaille Industries, Inc., Buffalo, N. Y., damper assemblies, for use on strut steering and main landing gear assemblies, on various aircraft, N383-64949A, (383/217385/60), various, $36,228.

Sundstrand Aviation Division, Sundstrand Corp., Rockford, Ill., transmissions, for P5M-1 and -2 aircraft, N383-64685A, (383/212142/60), 167 ea., $1,077,651.

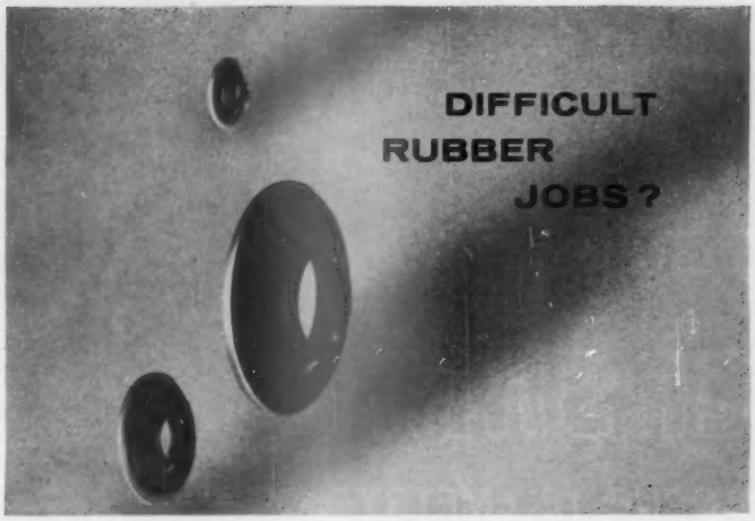
Weber Aircraft Corp., Burbank, Calif., cover assemblies, used on seats for various aircraft, N383-64644A, (383/217098/60), various, $27,012.

Aircraft Instrument Division, R. C. Allen Business Machines, Inc., Grand Rapids, Mich., indicators, turn and slip, to support various aircraft, N383(17-383)64877A, (PRAER 4350-60-PRAER-4388-60), various, $60,726.

B. E. Darling Co., Inc., Bethesda, Md., hose assemblies, oxygen, for A3D-1 and -2 aircraft, N383-64723A, (383/217521/60), various, $34,883.

The Goodyear Tire & Rubber Co., Akron, Ohio, wheel assemblies, aluminum, for F4D aircraft, N383-64909A, (383/211510/60), 155 ea., $40,173.

Spectrol Electronics Corp., a subsidiary of Carrier Corp., San Gabriel, Calif., resistors, to support potentiometers and generators for F4D-1 aircraft, N383-62556A (383/21690Z-60), $28,365.



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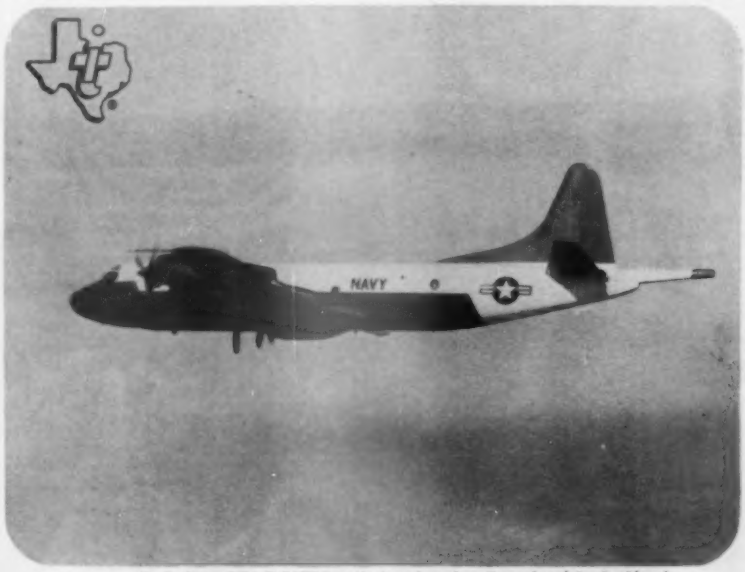

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CAB Accident Investigation Report:

Improper Recovery Cited in 707 Crash

On Oct. 19, 1959, at 1620 PST, a Boeing 707-227, N 7071, crashed and burned in the Stillaguamish River about 10 mi. northeast of Arlington, Washington. Four of the eight occupants aboard received fatal injuries; one of the four survivors received serious injuries.

A Boeing Airplane Co. test pilot was acting as an instructor-pilot on a demonstration and acceptance flight prior to the aircraft being delivered to the customer. The company was also utilizing this flight time for flight instruction purposes in qualifying airline personnel in the aircraft.

The instructor-pilot demonstrated several maneuvers, including Dutch rolls, to a pilot-trainee, an airline captain who was making his first training flight prior to checkout on the Boeing 707.

The instructor-pilot initiated a Dutch roll in which the roll-bank angle of the aircraft reached 40 to 60 deg. This bank angle is in excess of limitations set by the company for demonstration of this maneuver (AW June 27, p. 38). The pilot-trainee, who was to make the recovery, rolled full right aileron control while the right bank was still increasing. The aircraft immediately yawed and rolled violently to the right. The instructor-pilot immediately rolled in full opposite aileron. The airplane stopped its right roll at a point well past a vertical bank and then rolled to the left even more violently. Several gyrations followed and after control of the aircraft was regained, it was determined that three of the four engines had separated from the aircraft and it was on fire. The fire rapidly reduced controllability of the aircraft and an emergency landing was attempted; however, the aircraft struck trees and crashed short of the intended landing area because power on the engine remaining had to be shut down to keep the aircraft wings level.

Subsequent to this accident, the Boeing Airplane Co. flight training syllabus was revised to re-emphasize the maximum roll-bank angles permissible for the Dutch roll maneuver. In addition, demonstration of the Dutch roll has been put off until a later time in the curriculum so the pilot-trainees will have more flight experience before practicing the maneuver.

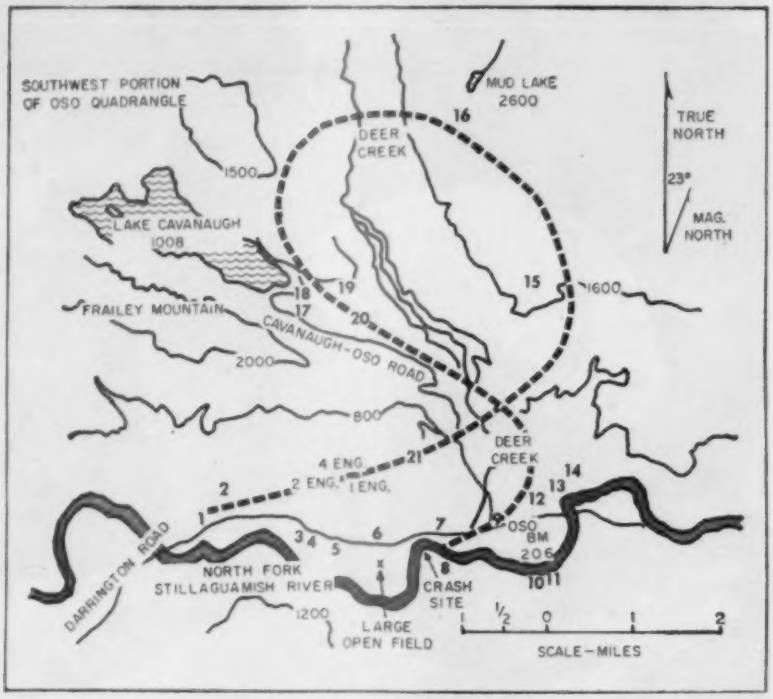
Investigation

N 7071 was a new model of the Boeing 707 series aircraft on which FAA type certification flight tests had just been completed. Final certification was awaiting verification of these test results and the aircraft meanwhile was being operated on an experimental certificate of airworthiness. The flight of Oct. 19, 1959, was one of a series of flights to demonstrate to the purchaser that the aircraft met the performance qualities guaranteed by the manufacturer, and to train the Braniff pilots.

The crew for this flight, which consisted of R. H. Baum, BAC (Boeing Airplane Co.), instructor-pilot; Captains J. A. Berke and M. F. Staley, BNF (Braniff Airways), copilots; and G. C. Hagan, BAC, flight engineer, all received fatal injuries when the aircraft struck the ground. The following personnel who were listed as passengers on the flight plan received minor to serious injuries at ground impact: A. C. Krause, BNF flight engineer; F. W. Symmank, BNF technical instructor; W. J. Allsopp, BAC pilot; and W. H. Huebner, FAA Air Carrier Operations inspector.

Mr. Baum, as pilot in command, conducted a preflight briefing of the crew. Takeoff data and takeoff procedures were discussed along with the maneuvers which were to be performed. An IFR (instrument flight rules) flight plan was filed for an estimated departure at 1330 PST.[1] The aircraft was serviced with sufficient fuel for five hours. Its gross weight was 208,000 lb. and the center of gravity located at 26.5% MAC (mean aerodynamic chord).

Shortly before departure the IFR flight plan was canceled and the flight proceeded according to VFR (visual flight rules) for an estimated 4-hr. and 15-min. flight. Captain Berke, who was making his first flight in the aircraft, occupied the left seat and Mr. Baum the right. Mr. Krause was performing the duties of flight engineer.



BROKEN LINE traces descending flight path of 707, ending at crash site in the Stillaguamish River. Numbers indicate positions of witnesses to the accident.

Maneuvers Demonstrated

After takeoff the flight proceeded normally through a series of maneuvers which were first demonstrated by Mr. Baum and then executed by Captain Berke. Several Dutch rolls in a clean configuration were initiated and the proper recovery was demonstrated by Baum. Captain Berke then made several recoveries from Dutch rolls in this configuration.

Following this, the aircraft was slowed to 155 kt. and 40 deg. of flaps were lowered. Captain Berke then made recoveries from a series of Dutch rolls in this configuration which were initiated by Mr. Baum. During these rolls, angles of bank greater than 25 deg. were permitted to develop.[2] Mr. Allsopp stated that he leaned over to Mr. Baum and reminded him of the bank-angle restriction. He said Baum indicated that he was aware of the restriction.

As all of Berke's recoveries up to this time had been made from the left (nose-left

[1] All times herein are Pacific Standard based on the 24-hr. clock.

[2] The BAC 707 training manual restricts the Dutch roll maneuver to a desired maximum roll-bank angle of 15 deg. and an absolute maximum of 25 deg.

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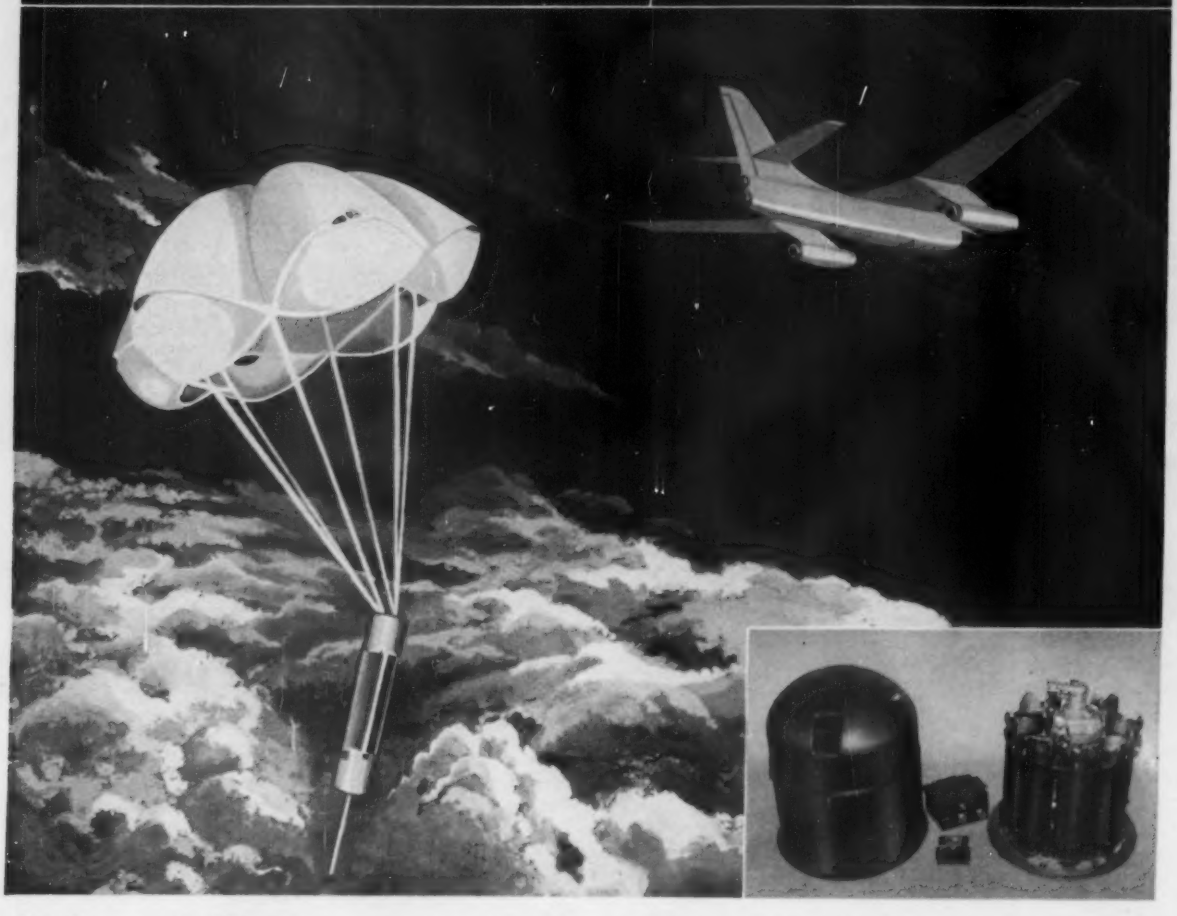

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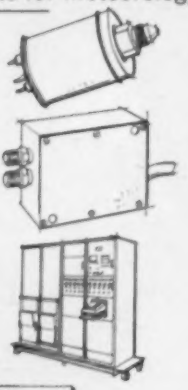

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Explanation of Dutch Roll

The term "Dutch roll" applies to a wallowing motion characteristic of swept-wing aircraft. During this motion the aircraft rolls right and left around the longitudinal axis while yawing right and left around the vertical axis. Angle of bank and degree of yaw are dependent upon the amount of force applied in initiating the Dutch roll.

Normally the motion is caused by turbulent air or lateral overcontrol. The low lateral directional damping of swept-wing design allows the motion to continue at slow indicated airspeed.

Compensating for the Dutch roll may be made by simply keeping the wings level. When the airplane is rolling in one direction or another, the aileron should be used to stop the roll and keep the wings level.

Another method is to apply cross-control. For example, if the aircraft is Dutch rolling, left rudder and right aileron should be applied when the nose has started to swing from left to right with control forces slowly relieved as the aircraft's yaw angle diminishes.

Rudder application must be applied in the right direction or the Dutch roll will be further aggravated. If there is uncertainty as to the rudder required, application of aileron only is recommended for recovery.

The damping in the lateral-directional mode is lowest when the angle of attack is high, so that at low indicated airspeeds with flaps up or down, the Dutch roll will seem to be more pronounced. At high indicated airspeeds the natural yaw-damping forces minimize or tend to zero out any Dutch roll tendencies.

The purpose of Dutch roll familiarization is to introduce to the pilots who are generally not acquainted with swept-wing airplanes this inherent characteristic peculiar to the design.

position), Baum suggested that a recovery be made from the right (nose-right). Baum then initiated another Dutch roll in which the angle of bank was quite large. Survivors estimated the aircraft rolled 40 to 60 deg. Before attempting recovery, Berke allowed the aircraft to complete several oscillations in each of which the roll-bank angle reached 40 to 60 deg.

The survivors stated that Berke initiated recovery while the right bank was still increasing. They said he applied full right aileron control while the right wing was still moving downward. The airplane immediately yawed heavily to the right and rolled rapidly to the right, well beyond a 90-deg. bank.

Immediately after Berke had applied right aileron and early in the yaw-roll movement of the aircraft, Baum took the controls and applied full left aileron. At this time the aircraft was rolling to the right. The roll stopped after the wings had passed the vertical and then rolled back to the left even more rapidly and violently than to the right. The survivors stated during these two rotations sounds were heard which could have been the engines separating from the aircraft. They also stated that during these rolls the thrust levers were seen to snap and the cables go slack.

Violent Movements

The movements of the airplane which followed were described as "spins" or "snap rolls." Although the exact number of rotations could not be determined, the survivors were in agreement that the aircraft rotated to the left and that the rate of roll finally slowed almost to a stop with the aircraft in an inverted nosedown attitude. The left roll was continued and the recovery was made to an upright position with the aircraft in a medium dive.

A normal pullout was made from the dive, during which it was noted that the engine instruments indicated complete absence of thrust on engines Nos. 1, 2, and 4. In addition, the thrust levers and start levers for engines Nos. 1, 2, and 4 were completely slack. Flight Engineer Krause also reported a complete loss of electrical power.

During most of the flight and throughout the uncontrolled gyrations of the aircraft, all eight occupants were on the flight deck. Immediately after control was gained, Mr. Huebner went aft to determine what, if any, damage had been sustained. He stated that No. 1 and No. 4 engines were gone and there were small fires in the areas where the engines had been. He said No. 2 engine was also on fire and it appeared that the forward mount had failed and the engine was hanging down at an angle with the tailpipe pointed into the flap.

Huebner went back to the flight deck and informed the pilots of his observations. Shortly after this Mr. Allsopp stated that he saw a very large fire burning in the area of the No. 2 engine and that that engine, as well as Nos. 1 and 4, was gone. The aircraft by this time had descended through the overcast and he suggested that an immediate ditching be made in Lake Cavenaugh, which was very close. Baum, who had taken over the controls at the first upset, was apparently looking for a more suitable landing area or attempting to reach an airfield nearby and continued his circle east of the lake (see chart, p. 159).

During this time Mr. Hagan took over the flight engineer's station. The four survivors—Krause, Symmank, Allsopp, and Huebner—then took ditching positions in the rear of the aircraft. The fire emanating from the area of No. 2 engine continued to burn fiercely. It was seen to burn a hole in the flaps and to consume most of the left inboard aileron. It also burned through

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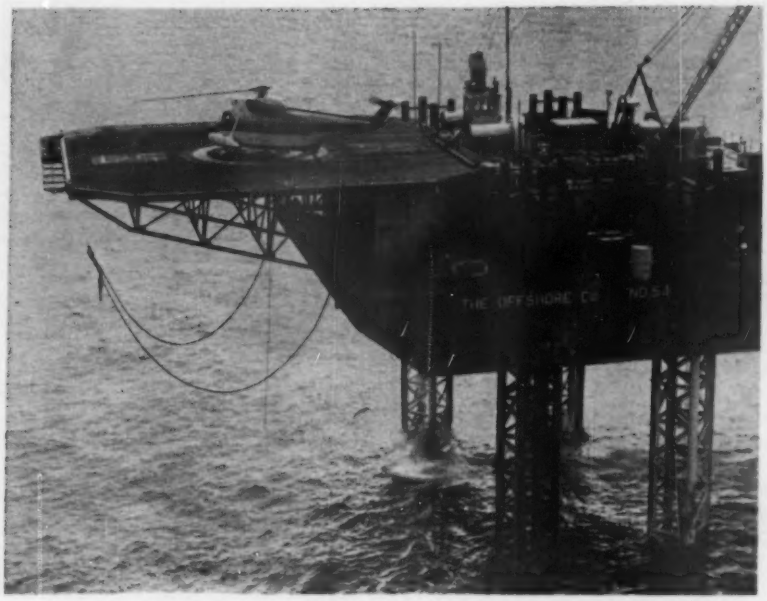


S-62 Lands at Off-Shore Mine Site

Sikorsky S-62 turbine helicopter lands at the Grand Isle offshore sulphur mine in the Gulf of Mexico. The helicopter made five 150-mi. round trips in one day.

the top wing surface and the survivors stated that they could see the structure in the interior of the wing.

Weather was not a factor in this accident although a thin broken to overcast cloud coverage existed over the entire area with ceilings reported as about 4,000 ft. A number of ground witnesses saw the aircraft after it had emerged from this overcast in its descent. The probable flight path of N 7071, depicted in the chart, is based on evaluation of the sightings of these witnesses.

Several witnesses located west of the final crash site described hearing the aircraft on an easterly heading in or above the clouds. They reported hearing an unusual sound similar to that of an aircraft breaking the sound barrier. Shortly after hearing this sound they saw three objects fall out of the overcast. These objects were located and proved to be engines Nos. 1, 2, and 4. The sound of a jet engine continued and the aircraft was seen to emerge from the base of the clouds on a northeasterly heading. It was on fire and descending. Other witnesses, located several miles farther east, saw the burning aircraft, still descending, make a sweeping left turn, passing near the east end of Lake Cavenaugh and straightening out on a southeasterly heading of about 110 deg. They said that during this turn they heard an explosion-like noise and the jet engine sound then ceased. The only sound which could be heard after this was a loud whistling noise. Several of these witnesses who were familiar with the Boeing 707 stated that there was only one engine on the aircraft and that a severe fire was burning in the area where the No. 2 engine had been. One witness said that the fire had burned away a large portion of the trailing edge of the wing in the area of the No. 2 engine.

The aircraft continued on its southeasterly heading down Deer Creek and then made a gradual right turn to a heading of 230 deg. By this time it had descended almost to treetop level. The aircraft continued on the heading of 230 deg. for about one mile, during which it descended until it contacted treetops and crashed in the Stillaguamish River bed approximately one-half mile short of a large open field which had undoubtedly been selected by Baum for the crash landing.

First Contact

The first contact with treetops 110 ft. high was on the north side of the river and nearly 1,400 ft. from the point at which the fuselage struck the ground. Four hundred feet from this first contact, the aircraft struck another row of trees along the north bank of the river, at a height of about 90 ft. The swath cut through these trees, which varied in diameter from 7 to 13 in., was approximately the width of the wing span and showed that the aircraft was in a wings-level attitude. A section of the left wing tip, 16 ft. long, was severed by contact with these trees. As the aircraft continued across the river the left wing, which was dropping rapidly, cut a path inclined at an angle of 45 to 50 deg. through more trees on the south bank. Toward the end of this cut through the trees, the left wing contacted the ground gouging several long ditches in the sandy soil. As the aircraft continued its forward travel, the left wing broke up progressively until finally the fuselage struck the ground.

The forward portion of the fuselage (station 960 forward) was almost completely destroyed by the impact and intense ground fire which followed. The aft fuselage, where the survivors were located, broke off just to the rear of the trailing edge of the wing and skidded out into the middle of the river. Although it was badly damaged by inflight fire and ground impact, it was intact and was not subjected to the ground fire which consumed most of the other wreckage.

The section of the left wing tip, severed by contact with the trees on the north side of the river, came to rest across the river approximately 50 ft. before the first of the gouges which were dug in the ground by the remaining wing structure. The wing, from the point at which the tip was severed inboard to the landing gear beaver tail strap, was broken up and sections were scattered along the ground path. Most of these pieces received damage from ground fire and large areas were consumed completely. Inboard of the beaver tail, the box section was nearly intact but partially consumed by ground fire, as was the center box section and inboard 30 ft. of the right wing. The remainder of this wing was broken into two major pieces which were partially consumed in ground fire.

Fire Damage

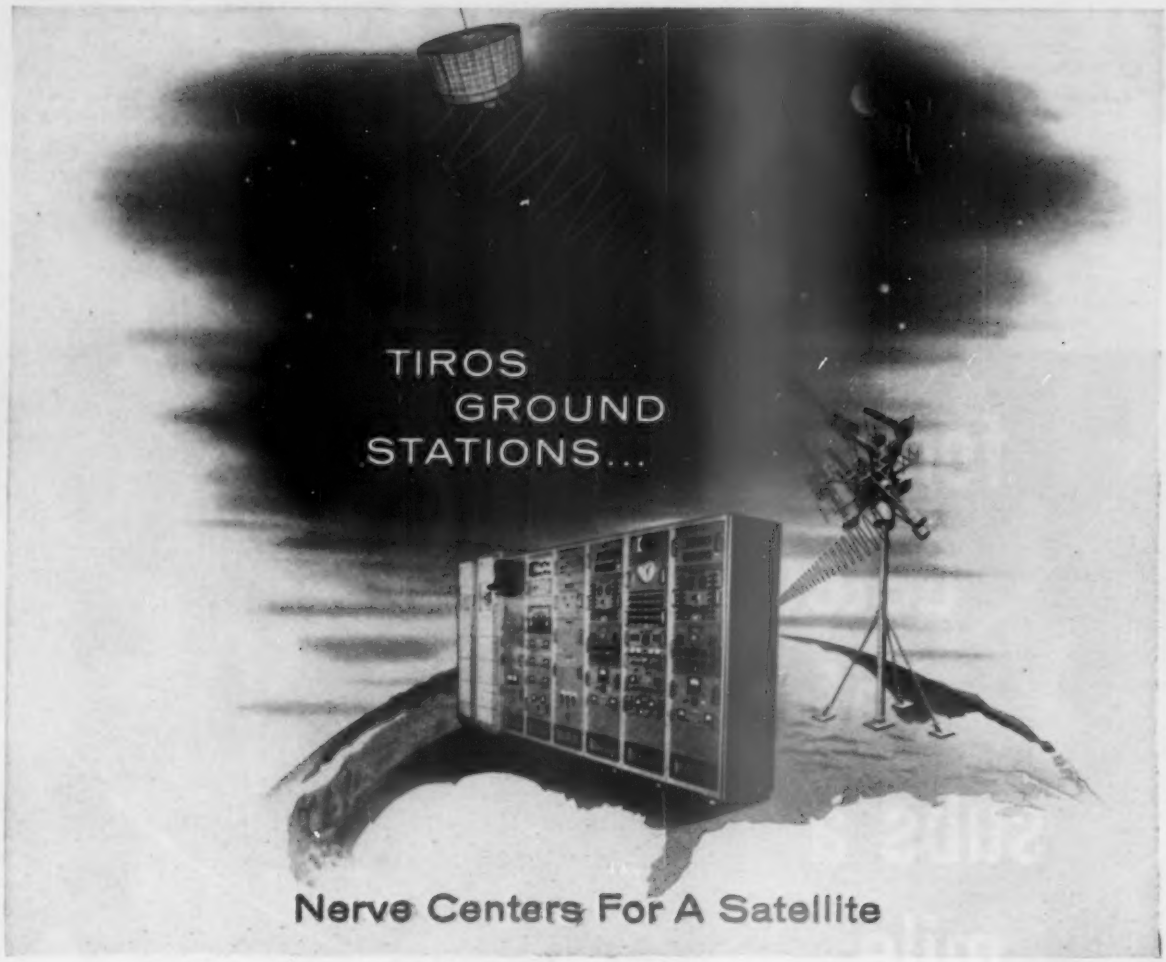
There was extensive inflight fire damage to the left wing in the area of the No. 2 engine, to the entire left side of the aft fuselage, and to the left side of the empennage.

The wing upper skin from the area of the aft end of the over wing pylon strap was identified. This skin was badly wrinkled by heat over each fuel vent channel and the skin over one was ruptured for a length of three feet. The edges of the rupture were curled outward, were very fibrous, and were heavily sooted, indicating that an explosion had occurred. In addition, rivets in the area which attached the skin to the vent were failed in tension.

From the rear spar aft, the wing trailing edge and flight controls were severely burned. The left inboard aileron and the entire trailing edge structure nearby were consumed except for small fragments. The inboard half of the No. 2 and the outboard half of the No. 3 spoilers were partly consumed. The outboard two feet of the No. 2 flap cove lip door was heavily sooted and a few small holes were burned in the skin. The internal structure in this area was consumed. The lower trailing edge just forward of the door was burned through and blackened.

The outer closing rib on the No. 2 flap was heat wrinkled. The flap lower surface was lightly sooted and the upper surface was heavily sooted. The inboard corner of the No. 1 flap was badly burned and three feet of its upper surface was consumed. It was determined that the flaps were extended approximately 28 deg. at impact. The left inboard spoiler valve fell from the aircraft about one mile from the crash site. It had large deposits of "runback" (solidified) aluminum on its lower side. The aileron trim mechanism and the aileron bellcranks also had these runback deposits on them. All control components in the area and even the rear wing spar web vertical stiffeners were badly burned by inflight fire.

The left side of the aft fuselage was heavily sooted and all of the windows were heat checked. In addition, paint on the rear loading door and on the fuselage aft to the stabilizer was blistered. Just forward of the vertical fin, light sooting angled across the fuselage top centerline and back



Nerve Centers For A Satellite

Over 25,000 informative cloud-cover pictures have been received from TIROS I since it was launched on April 1. In two months the satellite had completed 1000 orbits and travelled 27,500,000 statute miles. This means not only that TIROS itself has performed as planned, but that the complex problems of command and control, as well as signal reception and processing, have been successfully surmounted. Like the satellite, the special ground station equipments were designed and built by RCA Astro-Electronics Division under the auspices of NASA and technical direction of the U.S. Army Signal Corps.

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- An indexer and sun angle computer which generate an index number and sun angle indication for each picture, used for geographical orientation
- An attitude recorder which picks up the earth-horizon signal for spin axis position computation
- Two standard 4-channel tape recorders to back up the monitor
- Two paper recorders to monitor forty telemetered satellite parameters
- An antenna programmer which directs the antenna to follow the orbit of the satellite when it is in range of the ground stations

All program functions are timed by a master clock which is synched to standard time signals from WWV. In addition to normal picture direct transmission and record functions, the programmer can also command spin-up. After two months the spin rate had decreased to 9.4 rpm's due to the effect of the earth's magnetic field. On command from the ground, two solid propellent spin-up rockets on the satellite were fired, increasing the spin to 12.8 rpm's.

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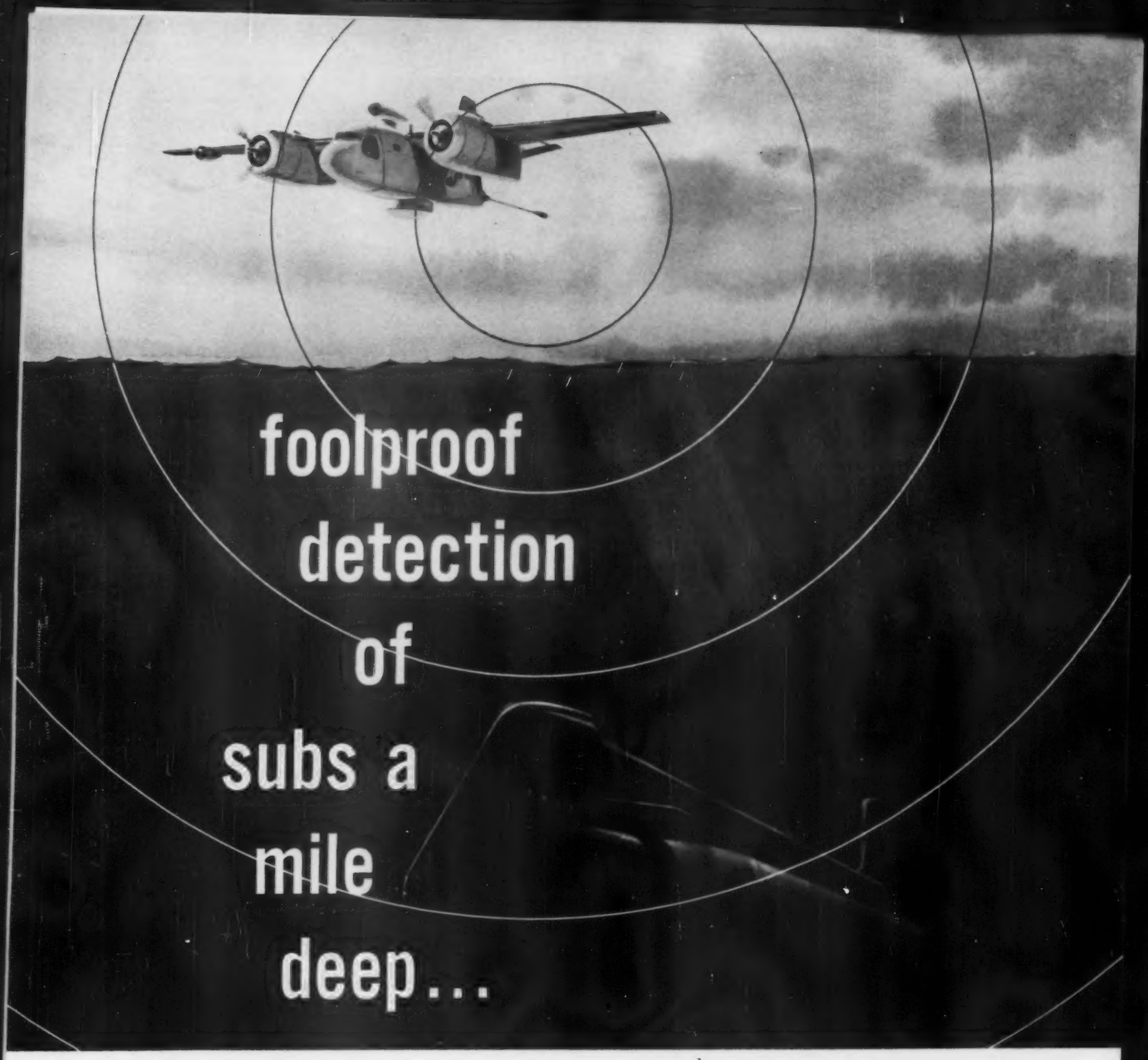

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along the upper right side of the tail cone and lower third of the right side of the vertical fin.

The lower half of the left side of the vertical fin was lightly sooted and paint was blistered and scorched. The lower balance panel covers were heat wrinkled. The lower half of the rudder was severely heat wrinkled. The left side of the tab was also heat wrinkled and heavily sooted. The right side of the rudder tab was lightly sooted from smoke which was drawn through the tab hinge, indicating right rudder trim during the fire.

The left horizontal stabilizer and elevator were sooted and heat wrinkled on the upper and lower surfaces. In addition, the severe fire from the left wing burned through the upper skin between the internal stiffeners.

Three of the four powerplants, with a major part of their pylons attached, separated from the aircraft in flight. They were found one to one and one-half miles northwest of the main wreckage. The Nos. 1 and 4 engines, with their nacelles, broke from the airplane in the outboard directions. The No. 2 engine, with its nacelle, broke partially outboard but appeared to have rotated downward and rearward during its separation from the aircraft. The No. 3 engine remained attached to the aircraft until impact. It was found at the main wreckage site. Investigation revealed that there were little or no indications of in-flight fire damage to engines Nos. 1, 3, and 4. However, the cowling which fell with the No. 2 engine showed evidence of heavy smoke and sooting prior to impact.

The damage found on all four engines was the result of impact or minor ground fire. No evidence of operational distress or malfunction prior to impact with the ground was found. In addition, indications were found on all four engines that they were rotating very slowly, if at all, at impact.

Public Hearing

During the public hearing a Boeing witness testified that pilots who have had an engineering background or test-pilot experience in the Armed Forces are selected as test pilots for Boeing. These pilots are then given extensive ground school training and flight experience under the supervision of instructor-pilots. He said before a pilot could be released as an instructor he had to have a check ride and approval by the Chief of Flight Test or his designee. He further stated that Baum had met all of these requirements and was considered fully qualified to conduct this particular flight.

The witness then described the company checkout and training program for airline personnel. He said the airline pilots would have had the 707 training syllabus for a considerable length of time prior to the beginning of flight training and would also have completed the ground school courses. A briefing would be conducted prior to flight which was a general review of the entire training syllabus. Immediately before each flight an additional briefing would be held to cover item by item the maneuvers to be accomplished.

The witness stated that the Dutch roll characteristic is present in all large aircraft but is more pronounced in those with swept-back wings like the 707. It is most likely to be encountered during approach to landing when the aircraft is at slow speed with a high coefficient of lift and in rough or turbulent air. He said the characteristic constituted a minor annoyance to pilots and slight discomfort to passengers and it was therefore desirable to give instructions in recovery technique.

All Boeing flight personnel had been informed that the desired maximum roll-bank angle in this maneuver was 15 deg. and that the absolute maximum was 25 deg. These restrictions were not imposed because of a structural limitation on the aircraft, but because the maneuver and its recovery could be satisfactorily demonstrated with these conservative limitations. Subsequent to the accident, Boeing re-emphasized the roll-bank angle limitations and deleted demonstration of the maneuver with flaps down because recovery can be demonstrated equally as well in the clean configuration. In addition, the Dutch roll training has been moved back in the training program so that the trainee will be more familiar with the characteristics of the airplane when the maneuver is demonstrated.

A flight recorder was installed in the aircraft but was not in operation during this flight.

Civil Air Regulations require the flight recorder to be in use during scheduled passenger operations only.

JetStar Seat

New seat for Lockheed JetStar executive jet transport is demonstrated by its designer, Henry Dreyfuss. Headrest is adjustable.

Analysis

There is little question that the violent gyrations of N 7071 which followed the improper Dutch roll recovery attempt resulted in the separation of the three engines and the inflight fire. A safety factor is designed into the nacelle supporting structure so that, in the event of abnormal loading, it will fail before destructive loads are transmitted to the aircraft wing. Separation of engines from the aircraft is therefore expected when the aircraft is subjected to high abnormal loadings such as occurred in this case.

It is equally clear that the Dutch rolls being performed reached angles of bank far in excess of the limitations established by the company. Responsibility for the safety of this aircraft rested solely on the instructor-pilot. The Board can find no valid reason for Mr. Baum initiating the final Dutch roll so violently. No training advantage could be gained by conducting these maneuvers at the extreme angles of bank reached. Baum certainly should have been aware of this and he was admittedly aware of the company's restrictions. In addition, it was surely less than prudent to permit a pilot with no previous experience in the airplane to attempt a recovery from this extreme maneuver.

The severity of the gyrations to which the aircraft was subjected developed loads greater than the design strength of the nacelle pylon structure. After the three engines were lost and while the flaps were still extended 40 deg., the airplane was committed to land. The flaps may have been raised to the 28-deg. position intentionally so that full outboard aileron effectiveness would be available during the landing. It is possible that in this configuration, with power available from the No. 3 engine, the airplane could have flown at least long enough to reach a suitable airport for a crash landing. However, the intense fire which is believed to have come from a ruptured fuel line, was threatening the left wing and made an immediate landing mandatory.

Lateral Control

Lateral control with flaps down at least 28 deg. is provided by the following: outboard ailerons, 40%; outboard spoilers, 30%; inboard ailerons, 15%; and inboard spoilers, 15%. The outboard ailerons are moved by means of a cable bus arrangement actuated by movement of the inboard ailerons. As the fire gradually destroyed the inboard left aileron and the flight control components in that area, the outboard ailerons were lost. Loss of electrical power cut out the auxiliary hydraulic system which operates the inboard spoilers and the rudder boost. When the left inboard aileron was consumed the only lateral control remaining to keep the heavily damaged left wing up came from the right inboard aileron (4%) and possibly the right outboard spoilers(30%). Lift on the left wing was seriously impaired because of the loss of approximately 35 sq. ft. of upper surface which was burned through, the additional fire damage to the flaps which reduced their effectiveness, the extra drag from the No. 2 pylon stub, and the spoiler effect on the upper wing surface caused by the ruptured skin over the fuel vent channels.

This drag, coupled with any appreciable thrust from the No. 3 engine, would force the left wing down. In view of the limited aileron control available, considerable right rudder would be required to induce a yaw to the right to assist in holding the wing up. However, with the rudder boost inoperative, there would not be sufficient rudder control available to induce enough yaw to counteract these forces. It is therefore apparent that the No. 3 engine was shut down prior to impact so as to be able to keep the wings level with the minimum amount of control available. This is

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also supported by the fact that the engine had almost stopped rotating at impact.

When the aircraft hit the trees on the north bank of the river and a 16-ft. section of the left wing was severed, the control available was insufficient to maintain the wings level. As it crossed the river, the aircraft rolled rapidly to the left to a bank angle of approximately 55 deg. and crashed on the south bank.

Conclusions

The Board concludes that this accident was the result of the structural failure of the Nos. 1, 2, and 4 nacelle pylons, and the fire in the area where the No. 2 nacelle broke off. It also concludes the nacelles failed as a result of overloads imposed on them during several violent uncontrolled gyrations which were encountered when the pilot-trainee applied improper control movement in an attempt to recover from a Dutch roll.

The Board further concludes that the instructor-pilot initiated the Dutch roll to an angle of bank far in excess of the limitations imposed by the company. In addition, the instructor-pilot was fully aware of these limitations and was, in fact, reminded of them during this flight. Even so he permitted the pilot-trainee, who was on his first training flight, to attempt recoveries from these extreme maneuvers.

It concludes that after control of the aircraft had been regained, Mr. Baum had selected an excellent clear area for the imminent crash landing but failed to make it by one-half mile because the No. 3 engine had to be shut down prematurely to keep the wings level.

Subsequent to the accident the company revised its training syllabus to reduce the possibility of recurrence of a similar accident. The limitations on angle of bank for the Dutch roll maneuver have been reemphasized to all company pilot personnel. In addition, Dutch roll familiarization has been delayed so that the pilot-trainee will have more experience in the aircraft prior to attempting this maneuver.

The company has also incorporated a full-time boosted rudder system in the aircraft. In addition, it has increased the vertical stabilizer area and has added a ventral fin. These changes are anticipated to substantially increase the low speed control characteristics of the aircraft.

Probable Cause

The Board determines that the probable cause of this accident was the structural failures induced during an improper recovery attempt from a Dutch roll which exceeded the angle-of-bank limits prescribed by the company.

By the Civil Aeronautics Board:

WHITNEY GILLILLAND
Chairman

CHAN GURNEY
Vice Chairman

G. JOSEPH MINETTI
Member

ALLAN S. BOYD
Member

The Civil Aeronautics Board was notified of this accident at 1800, Oct. 19, 1959. An investigation was immediately initiated in accordance with the provisions of Title VII of the Federal Aviation Act of 1958. A public hearing was ordered by the Board and held at the Olympic Hotel, Seattle, Washington, on Nov. 19, 1959.

Mr. Russel H. Baum, age 32, was employed by Boeing Airplane Co. June 7, 1957, as a Test Pilot "B." He was promoted May 2, 1958, to Experimental Test Pilot "B." He held an FAA airline transport pilot certificate with a rating in the B-707. His total flying time was 5,015 hr., of which 369 were in the 707. His latest FAA class I physical was taken June 2, 1959. Mr. Baum had received a total of 86 hr. of ground school instruction on the 707, plus a cockpit and systems familiarization class on the KC-135. According to testimony of a Boeing Airplane Co. employe, Mr. Baum was fully qualified to act as instructor-pilot on the 707.

Capt. John A. Berke, age 49, was employed by Braniff Airways Apr. 15, 1936, was promoted to captain in April, 1938, and to check pilot Jan. 1, 1958. He had a valid FAA airline transport pilot certificate with ratings in the DC-3, DC-4, DC-6, DC-7, and L-188 aircraft. Capt. Berke had a total of 23,563 flying hours. His latest first-class physical examination was taken Apr. 3, 1959. Capt. Berke had completed the Boeing Airplane Co. pilot training ground school course which consisted of 160 hr. of instruction. This was his first training flight in preparation for checkout in the aircraft.

Capt. M. Frank Staley, Jr., age 43, was

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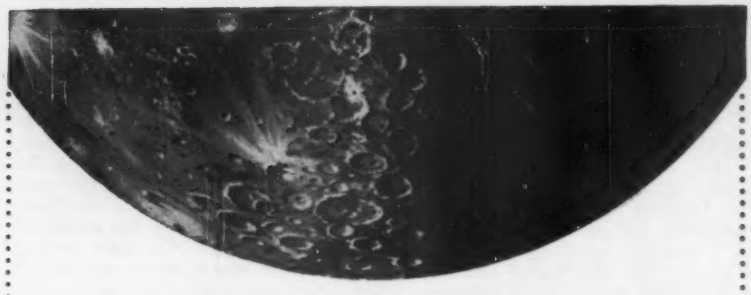

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employed by Braniff Airways Aug. 18, 1939. He was promoted to captain Nov. 1, 1942, and to check pilot Aug. 28, 1959. He held a valid airline transport pilot certificate with ratings in the DC-3, DC-6, DC-7, and L-188. Capt. Staley had accumulated 20,450 flying hours. His last first-class physical was taken June 23, 1959. Capt. Staley had completed the Boeing Airplane Co. pilot ground school training course of 160 hr. of instruction. This was his first training flight in preparation for checkout in the Boeing 707.

Flight Engineer George C. Hagan, age 28, was employed by Boeing May 11, 1959, as a Flight Test Analyst "A." He held a valid FAA flight engineer certificate. His last second-class physical examination was taken May 27, 1959. He had accumulated a total of 1,260 flight hours, of which, as of Aug. 29, 1959, about 90 had been in the Boeing 707. Mr. Hagan had completed a training course, consisting of 152 hr. for flight crew ground instructors, June 12, 1959.

The Aircraft

N 7071, a Boeing 707-227, serial number 17691, was manufactured June 11, 1959. It was owned and was being operated by the Boeing Airplane Co., Renton, Washington. The aircraft was a new model on which about 173 flying hours had been accumulated for the purpose of qualifying it for certification by the FAA. The airplane was equipped with four Pratt and Whitney turbojet, model JT4A-3 engines.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

AiResearch Manufacturing Co. of Arizona Division, The Garrett Corp., Phoenix, Ariz., power units, gas turbine engine, type A/A32A-3, FSN/2835-684-8097, Aerno 42-2352, 20 ea., and related data, aircraft usage: installation and spares in C-130B, (PR's ES-0-2835-6273; ES-0-2835-6441), $260,904.

Bendix Support Equipment Division, Bendix Aviation Corp., Teterboro, N. J., fabrication, furnishing and testing of type AN/GJQ09 programing set, checkout sequence with related spare parts, ground support equipment, engineering data, technical publication, management engineering services, programing manuals and self-test tapes, (PR's 60530 and SO-0-1410-3073), $1,454,703.

General Electric Co., West Lynn, Mass., transmitter, rate of flow, inflight refueling, 0-10000 RPM, type MB-3, contractor's P/N 6680-585-5309, Aerno 61-2474, 77 ea., and maintenance data, use: for support of KC-135A aircraft, (PR's ES-0-6680-6314; ES-0-6680-6573 and amendment 1), $119,834.

Montrose Division, Bendix Aviation Corp., South Montrose, Pa., transmitter, pressure, hydraulic, type MJ-1, FSN 2334-6685-530-3538, Montrose Division P/N 7609-37-D5-2, Aerno 61-2358, 338 ea., end use: for support of F-101B, F-105D, T-38, B-52G, T-39A, B-52H and T-38A aircraft, IFB 33-600-60-144(PR's ES-0-6685-6524 and amendment 1), $32,143.

AiResearch Manufacturing Co. of Arizona Division, The Garrett Corp., Phoenix, Ariz., drive assemblies, constant speed, pneumatic, type MC-1, contractor's P/N 351030, FSN 1650-768-6378, Aerno 42-0975, 28 ea., engineering and maintenance data, use: installations in F-105D aircraft, (PR's ES-0-1650-6804; ES-0-1650-6992; OC-0-1650-2338 and amendments 1 and 2), $253,540.

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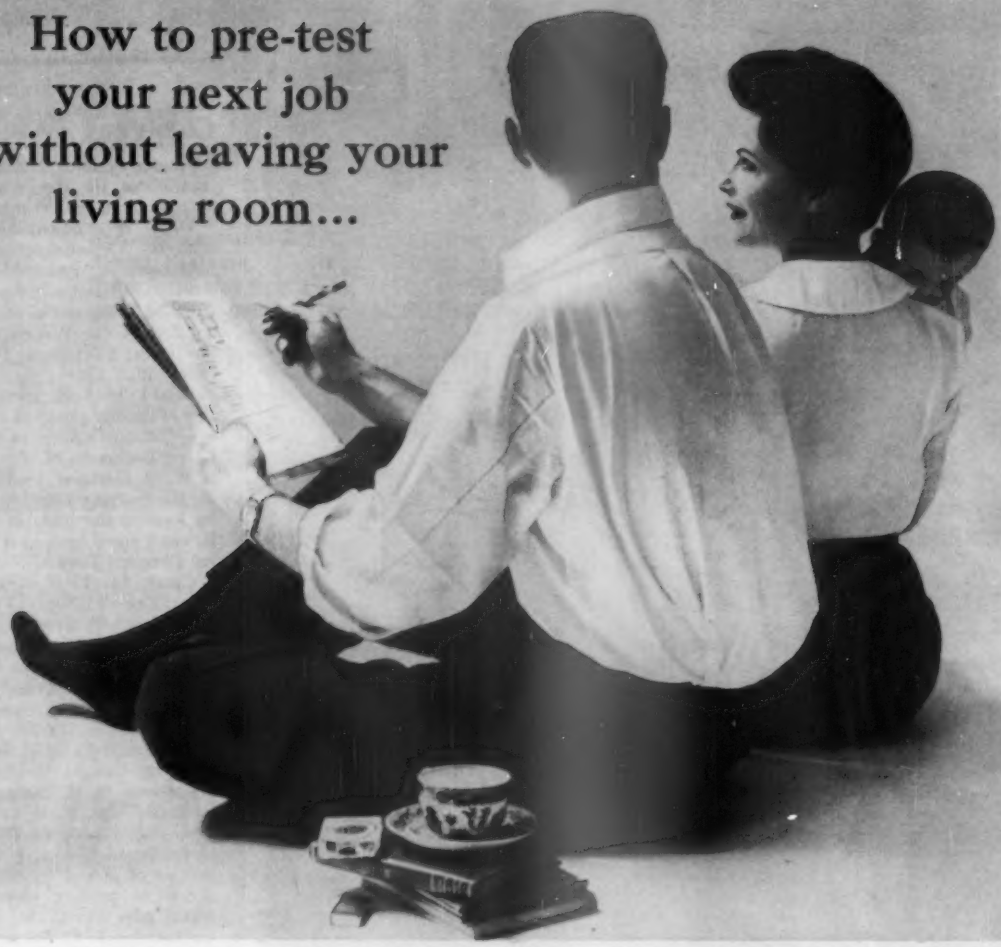

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WHO'S WHERE

(Continued from page 23)

Changes

Homer Pershing Davis, technical liaison coordinator for the Washington, D. C., area for Tracerlab, Waltham, Mass.

Dr. J. W. Nielsen, manager, Solid State Materials Department, Advanced Devices Laboratory of Airtron, Morris Plains, N. J., a division of Litton Industries.

C. N. Bates, special assistant to the chief engineer of the Washington, D. C., office for Ryan Electronics Division of Ryan Aeronautical Co.

Beryl L. McArdle, scientific adviser on the staff of the vice president-engineering, Stromberg-Carlson Division of General Dynamics Corp., Rochester, N. Y.

W. M. Davidson, head of a newly formed nuclear unit at Parsipanny-Troy Hills, N. J., for research and study of nuclear propulsion for space travel by Rocket Operations, Thiokol Chemical Corp.

Curtis M. Lee, chief engineer, Wyle Manufacturing Corp., El Segundo, Calif.

Dr. France B. Berger, director of research, GPL Division of General Precision, Inc., Pleasantville, N. Y. Also: **Harry J. Reed** and **Raymond Klemmer,** director and associate director of planning respectively.

The Allison Division of General Motors, Indianapolis, Ind., has announced the following changes in the Aircraft Engine Operations: **R. H. Ludington,** supervisor of jet engine sales; **R. E. Lowry,** supervisor of small engine sales; **D. R. Orme,** supervisor of aeroproducts sales; **J. D. Beaumont,** supervisor of prop-jet conversion engines. Assigned to product planning analysis and rocket sales are: **C. H. Clark, Jr.,** rockets and nozzles; **F. C. Spinney,** research; **C. B. Gaugh, Jr.,** product planning.

Gerald Q. Decker, manager of marketing for RCA's West Coast Missile and Surface Radar Division, Los Angeles, Calif.

Martin Boe, weapon system manager of the GAM-77 Hound Dog program, North American Aviation's Missile Division, Downey, Calif., and **A. C. Van Leuven,** assistant Hound Dog manager.

James R. Bruce, assistant manager of Northrop Corp.'s Huntsville, Ala., district office.

Francis X. Buschman, director of research, development and engineering, Hitemp Wires, Inc., Westbury, N. Y.

R. D. Nielsen has been appointed Douglas Aircraft Co.'s liaison representative to the North American Air Defense Command, Colorado Springs, Colo.

B. F. Coffman, Jr., manager of hybrid rocket engine projects, Aerojet-General Corp., Sacramento, Calif.

William M. O'Hern, corporate director of public relations, Lear, Inc., Santa Monica, Calif.

Dr. Harry Letaw, Jr., marketing manager for surface radar and navigation operations, Raytheon Co., Waltham, Mass., succeeding **A. E. Kelcher, Jr.,** now manager of marketing planning, Raytheon's Equipment Division.

John R. Shields, Jr., production manager for the Rialto, Calif., rocket motor plant of B. F. Goodrich Aviation Products.

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GROUND OPERATIONS ENGINEER

EDUCATION

Minimum B. S. — Aeronautical, Mechanical, Electrical.

EXPERIENCE

Minimum five years Flight Test planning, operations,or testing. Experience may be civilian or military.

DUTIES

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2. Prepare and release work sheets to accomplish the preparation of aircraft for test (i. e. direct and instrumentation or modification of the aircraft, coordinate weight and C. G. changes, coordinate changes in the aircraft with crew and maintain history of test craft).

3. Be present in radio room during flight to answer questions and make recommendations to the flight crew and attend post-flight meetings to insure completion of all items for test, and proper follow-up on failures, or unsatisfactory conditions on instrumentation, controls, systems, or equipment.

4. Review, coordinate, and prepare bailed aircraft for redelivery.

TEST OPERATIONS ENGINEER

EDUCATION

Minimum B. S. Aeronautical, Mechanical, Electrical

EXPERIENCE

Minimum five years Flight Test programs planning, operations, or interpretation. Experience may be civilian or military.

DUTIES

1. Plan the flight test in accordance with the test data requirements, point out hazardous conditions or impossible test conditions in a proposed flight test, determine the test will produce the desired information and determine method of data reduction to provide results.

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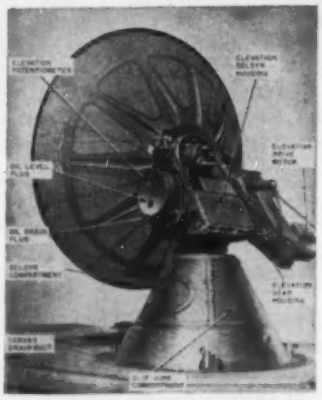

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AVIATION WEEK, JULY 11, 1960

AERO SERVICE CORPORATION 8
AEROJET-GENERAL CORP. ..... 2nd Cover
AERONCA MANUFACTURING COMPANY 130
AIRBORNE ACCESSORIES CORP. 6
AIRWORK CORPORATION 93
ALLISON DIVISION OF GENERAL MOTORS CORP. 120-122
ALUMINUM CO. OF AMERICA, MISSILES, AVIATION ORDNANCE 10
AMP INCORPORATED 66
AMERICAN AIRLINES, INC. 42
AMERICAN ELECTRONICS, INC. 88
AVCO CORPORATION ..... 4th Cover
AVNET ELECTRONICS CORP. 35

BAUSCH & LOMB OPTICAL CO. 73
BENDIX PIONEER CENTRAL DIVISION, BENDIX CORPORATION 117
BENDIX PRODUCTS DIVISION, BENDIX CORPORATION 122
BENDIX SCINTILLA DIVISION, BENDIX CORPORATION 154
BENDIX SYSTEMS DIVISION, BENDIX CORPORATION 142
BUDD COMPANY, THE 123

CANADAIR LIMITED 46
CANNON ELECTRIC COMPANY 64-65
CANNON MUSKEGON CORPORATION 136
CESSNA AIRCRAFT CO. 79, 167
CHERRY RIVET DIVISION, TOWNSEND CO. 61
CLIFTON PRECISION PRODUCTS CO., INC. 3rd Cover
COLLINS RADIO COMPANY 58
COLUMBUS, A DIVISION OF NORTH AMERICAN AVIATION, INC. 72
CONSOLIDATED DIESEL ELECTRIC CORP. AIRCRAFT EQUIPMENT DIV. 160
CONSOLIDATED ELECTRODYNAMICS CORP. 131
CONTINENTAL MOTORS CORPORATION 151

DECKER CORPORATION, THE 124
DEUTSCH COMPANY, THE 125
DOUGLAS AIRCRAFT CO., INC. 53

THOMAS A. EDISON, INSTRUMENTS DIV. McGRAW-EDISON 11
ELECTRO INSTRUMENTS, INC. 106
EMCOR INGERSOLL PDTS. DIV., BORG-WARNER CORP. 147
ESSO STANDARD OIL CO., DIV. OF HUMBLE OIL & REFINING CO. 152

FAIRCHILD ENGINE & AIRPLANE CORP. 92

G. M. LABORATORIES, INC. 161
GARRETT CORPORATION, THE 101
GENERAL ELECTRIC CO. 9, 85-86, 105
GENERAL ELECTRIC CO., HEAVY MILITARY ELECTRONIC DEPT. 94
GENERAL ELECTRIC LIGHT MILITARY ELECTRONIC DEPT. 109
GENERAL ELECTRIC CO., X-RAY DEPT. 16
B. F. GOODRICH CO., THE 22
GROVE VALVE & REGULATOR COMPANY 137

HARRISON RADIATOR DIV. GENERAL MOTORS CORP. 17
HAWKER SIDDELEY AIRCRAFT LTD. 12
HI-SHEAR RIVET TOOL CO. 13
HOFFMAN ELECTRONICS CORP., SEMICONDUCTOR DIV. 60
HORKEY-MOORE ASSOCIATES DIV. HOUSTON FEARLESS CORP. 71
HYDRO AIRE COMPANY 3

INTERNATIONAL BUSINESS MACHINES CORP. 7
INTERNATIONAL NICKEL CO., INC. 166

KAMAN AIRCRAFT CORP. 156

LEACH CORPORATION 90-91
LIBRASCOPE DIV. GENERAL PRECISION INC. .. 24
LITTON INDUSTRIES 153
LITTON INDUSTRIES ELECTRON TUBE DIV. ... 116
LIQUIDOMETER CORPORATION 14
LOCKHEED MISSILES & SPACE DIV. LOCKHEED AIRCRAFT CORP. 20

MARQUARDT CORPORATION, THE 88-89
MARTIN COMPANY, MARTIN ORLANDO DIVISION 170
McGRAW-HILL BOOK COMPANY 15
METALS & CONTROLS DIV. TEXAS INSTRUMENT INCORPORATED 82
MINNEAPOLIS HONEYWELL REGULATOR COMPANY 86-87, 107
MOTOROLA, INC., MILITARY ELECTRONICS DIV. 120-121

NEW DEPARTURE DIV., GENERAL MOTORS CORP. 62
NICHOLS CO., W. H. 103
NORDEN DIV. UNITED AIRCRAFT CORP. 132
NORTHROP CORPORATION 110

PORTER CO., J. K., INC., THERMOID DIV. 104
PRATT & WHITNEY DIV., UNITED AIRCRAFT CORP. 44

RADIATION, INC. 70
R. C. A. INDUSTRIAL ELECTRONIC PDTS. 100
R. C. A. ASTRO ELECTRONICS DIV. 163
REEVES INSTRUMENT CORPORATION 78
RESISTOFLEX CORPORATION 108-109
ROCKETDYNE, A DIVISION OF NORTH AMERICAN AVIATION, INC. 108
ROHR AIRCRAFT CORPORATION 87
ROLLS ROYCE LIMITED 36
RYAN AERONAUTICAL CO. 164

SARGENT ENGINEERING CORP. 4
SEISCOR, A DIV. OF SEISMOGRAPH CORP. 95
SERVICE STEEL, DIV. VAN PELT CORP. 93
SERVOMECHANISMS, INC. 5
SOUTHWESTERN INDUSTRIAL ELECTRONICS CO. 158
SPERRY GYROSCOPE CO. DIV. OF THE SPERRY RAND CORP. 89
STONER RUBBER COMPANY 157
SYLVANIA ELECTRIC PDTS., INC. 81

TEXAS INSTRUMENTS INCORPORATED 151, 153, 155, 157
THOMPSON-RAMO-WOOLDRIDGE, INC., TAPCO GROUP 134-135
TIMKEN ROLLER BEARING CO. 112
TUBE METHODS, INC. 84

UNITED STATES STEEL CORPORATION ... 74-75, 114

VERTOL DIVISION, BOEING AIRPLANE COMPANY 98-99
VICKERS, INC., DIV. SPERRY RAND CORPORATION 18

WESTINGHOUSE ELECTRIC CORPORATION 50-51
WYMAN-GORDON COMPANY 144

YUBA CONSOLIDATED INDUSTRIES, INC. 111

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 171-172
EQUIPMENT
(Used or Surplus New)
For Sale 172

ADVERTISERS INDEX

Boeing Airplane Company 171
East Coast Aviation Corp. 172
Graubert Aviation, Inc. 172
Lear, Inc. 172
Miller Aircraft Corp. 172
Radio Research Instrument Co. 172
Watson Aviation, Inc. 172
Zep Aero 172

LETTERS

Work Well Done

For the past five years two men, David Aldridge and Ray Block, have been doing an outstanding job as the airborne engineering section of RCA at the Atlantic Missile Range, Patrick AFB. These men have the responsibility to engineer all modifications to the Air Force range aircraft so they can do the job of tracking missiles.

The aircraft have included helicopters, fighter and bomber type planes; however, the primary modifications have been to the C-54s and C-131s used. These planes are completely remodified into JC-54s and JC-131s. Many modifications are not as extensive nor do they allow the months of work that go into the making of JC-54 and JC-131 aircraft.

An example of what I mean is the cover picture used on the June 13 issue of Aviation Week. This is a JC-54, not a C-54 as captioned. The door modification for the equipment shown in the photograph had to be designed, built and test flown in only a few days. The design, in fact, was the making of two new doors that allowed for the top half to be opened in flight, and special fixtures to hold the test equipment.

It is true, if they didn't do the work someone else would, but they are doing it and should be congratulated on work well done. (Name withheld by request.)

Talent, Ltd.

I am sending you some comments which by this time I hope have not grown too stale. In the light of the U-2 fiasco, an immediate reconstruction of the State Department and of Central Intelligence is essential. The adoption of well proven business procedures to this end is indicated.

To restaff the State Department, in the absence of qualified talent locally, a raid on the British Foreign Office immediately suggests itself. Personnel offices should therefore be set up in one of the better London hotels and advertising placed in the London Times, Manchester Guardian and other papers as well as the usual trade publications. Recruiting would be in charge of one or other of the better Executive Employment Agencies rather than of State Department personnel whose record has been so obviously disastrous.

Recruiting practice would follow the established lines of such leaders as Hughes, Lockheed, and others in the airframe and electronic industries. Evening and over-the-weekend interviews would be granted so as to cause the minimum of inconvenience to present employment and avoid the possibility of putting it in jeopardy. Personnel officers would dwell on the rigors of the British climate, on the uniformly delightful weather to be enjoyed on the eastern seaboard, and on the cultural, social, educational and other amenities available to the successful applicant. While attempt would be made to avoid unduly hurting the feelings of prospective employes, these must sometimes become accustomed to the aloof omniscience of the personnel director and might as well get started.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Unquestionably it will prove necessary to offer in addition to the customary platitudes substantially higher pecuniary inducements, say 50 to 100% in place of the usual 10 or 15% over those previously enjoyed, in the absence of stock option, bonus, and other such emoluments as well as because of the disrepute into which the prospective employer must be considered to have fallen.

With the CIA the problem of recruiting competent help is one of possibly even greater difficulty, though not insuperable. Here a raid on the FBI and various police agencies is obviously suggested. Difficulty, however, lies in the well known prejudice against recruiting from other corporate divisions. This may be circumvented through the use of customary trade techniques; the situation clearly must be handled "ethically." Candidates must be selected without interview through outside scrutiny and approach made through mutual friends. The advantages of a new connection may be thus disclosed and firm assurance of profitable transfer given.

The candidate will then resign from the FBI or the police, giving ill health, a desire to go into business for himself, his wife's dissatisfaction with the climate, or other reason. He will be then available for direct approach and a transfer may be effected without lost time on the job especially if arranged in conjunction with a regular vacation period with due consideration given to the customary liberal governmental sick leave benefits.

S. L. Baring-Gould
Boston, Mass.

Arms and Atoms

I have read Aviation Week for about six years now and have appreciated its technical information. It is only recently that it became clear to me that an attempted "made in U.S.A." brainwashing is being done for an obvious armaments race which will terminate in nuclear holocaust; where there is a huge stockpile there will be accidents, miscalculations and certainly some mental defectives will show up to increase the probability of human failure at a crucial moment.

I read a very revealing book recently which I challenge you to examine. It is called "I. G. Farben" and the author, Mr. Sasuly, outlines the history of this gigantic cartel, its relationship to our giant corporations via agreements, licensing, and patent suppression abuses, leading to shortages of rubber, aluminum, carboloy, and many other wartime essentials for U.S. armed forces in World War II. I also suggest you examine a book "Patents for Hitler" by Guenter Reimann. You will see a sordid tale of armament races, profits derived at many little peoples' expenses. I also suggest you examine "The Failure of Atomic Strategy" by F. O. Miksche; another small book, "Fall Out," by a group of experts edited by A. Piric with forward by Bertrand Russell (1958). And last but not least, do examine your conscience and see if you deserve that strontium 90 in your bones and in my children's bones. Try to prove in your next editorial that the human race will be made better by mutations, that the present stupid and stupendous armaments race is the product of sanity.

Daniel B. Nisanbaum
Manhattan Beach, Calif.

Pressure Groups

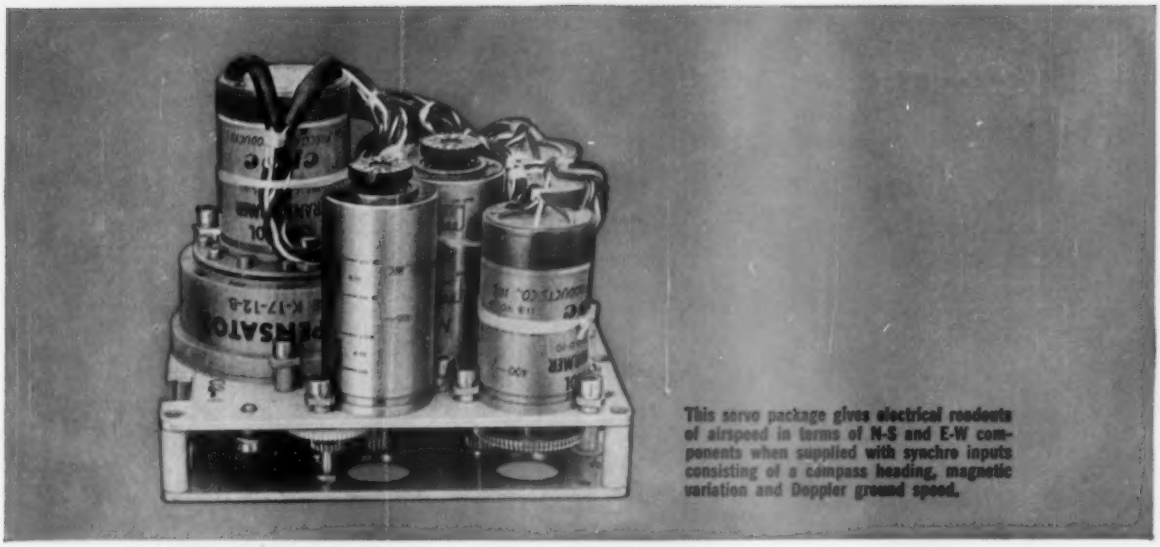
Your recent editorial complaining about the activities of pressure groups operating in the aviation field indicates a lack of awareness of what may well be the greatest danger facing a free United States today. You seem to feel that the end justifies the means in matters connected with aviation and the FAA. We in the U.S. face an ever growing internal threat to our liberties from the increasingly arbitrary encroachment of government; in particular, the federal bureaucracy as exemplified by the excesses of the Department of Agriculture, for one, and now the growing threat of the FAA. Organizations which resist these actions may well be one of our last defenses before the onslaught of big government.

I recognize that Aviation Week attempts to concentrate upon military and airline activities and gives only a limited coverage of general aviation. However, you should be aware that general aviation, by the FAA's own statistics, comprises the bulk of civil air activity as opposed to the scheduled airlines' use of only 1.8% of the civil air fleet and 8% of the civil airports. It is quite disturbing that the FAA shows a very minor interest in general aviation. The worst danger in the situation is the arbitrary, undemocratic approach the FAA takes in the rush for progress (so-called). Also, when we actually get down to cases we find the FAA often flagrantly refusing to enforce safety on the one hand while using it as a front for all sorts of activity elsewhere. By way of contrast, the FAA field personnel I have dealt with are tops, probably because they live with reality.

Fortunately, we have some men in Congress who are as much interested in preserving our civil liberties as they are in favor of change in the name of progress on the aviation front. One of these men, Sen. Engle of California (a pilot himself), said in connection with the recent hearings on the Federal Aviation Act." . . . [FAA administrator] makes the rule, then turns around and acts as judge, jury, and prosecutor . . . it violates every basic concept of Anglo-Saxon law and justice. . . ."

Richard L. Hart
Palo Alto, Calif.

(Aviation Week differs with Reader Hart that its general aviation coverage is limited, since it covers this field through its weekly Business Flying, Equipment, Avionics and late news section as extensively as the military and airline field.—Ed.)



This servo package gives electrical readouts of airspeed in terms of N-S and E-W components when supplied with synchro inputs consisting of a compass heading, magnetic variation and Doppler ground speed.

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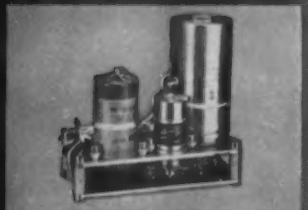
Clifton Heights Pennsylvania

This "Synchronizer Drive" servo package is used to null out gyro signals before an aircraft's autopilot is engaged.



This "Synchronizer Drive" can be used to null out transmitter signals. A wide variety of gear ratios is available as well as the option of two speed operation.

This transducer servo package converts a mechanical shaft input into a linear precise electrical output when a 28v dc signal is applied. It is particularly useful in aircraft for position information transmission of air surface controls.

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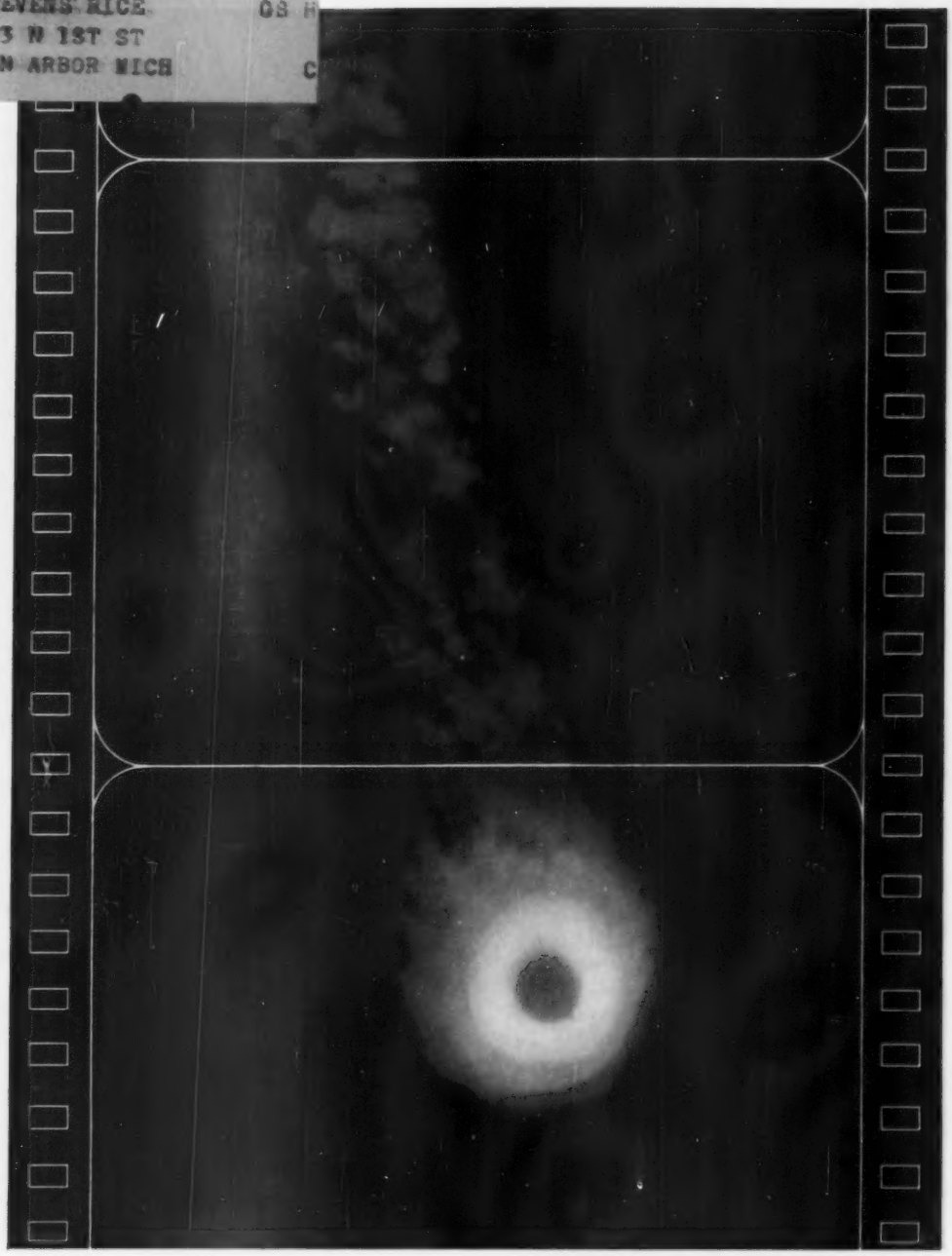

Re-entry portrait at 12,000 MPH. Critical performance data of re-entry vehicles at temperatures exceeding 12,000 degrees are obtained by a re-entry monitoring team from the Avco-Everett Research Laboratory. Portraits under these difficult conditions are obtained regularly as part of a general research program to study re-entry phenomena and related problems. Airborne equipment is used to acquire radiation data, trajectory information, and photographic documentation.

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